BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2020-21 (Summer Semester)

B. Voc. 5th Semester

End-Sem. Examination

Course Code: HVA1501 **Time: 2 Hours**

Course Name: Heat Load Estimation **Max. Marks: 50**

Instruction: Attempt all questions

Calculator is allowed

SET-A

Section – A

10X01 = 10 Marks

1. Which of the following is not a requirement for vapor barrier?:
   a) Durability b) Strength c) Rigidity d) None of the above

2. The rate of convection heat transfer depends on the _____difference:
   a) Temperature
   b) moisture
   c) Pressure
   d) None of the above

3. Dependency on the wavelength is referred to as –
   a) Spectral
   b) Specular
   c) Both A&B
   d) None of the above

4. Which of the following is not a radiation property?
   a) Absorptance
   b) Emittance
   c) Conductance
   d) Reflectance

5. Which of the following is not a type of transmission loss?
   a)Type of material
   b)Area of material
   c)Thickness
   d)Pressure

6. The lighting use factor (F_{ul}) is the ratio of the wattage actually in use at the time that the load estimate is being made to the total _____wattage.
   a) Installed b) Consumed c) Overall d) all of the above.

7. Surfaces for which the properties are effectively independent of the direction are referred to as:
   a) Grey Surfaces
   b) Diffuse Surfaces
   c) Spectral surfaces
   d) None of the above

8. Average fan efficiency is about:
   a) 35% b) 40% c) 65% d) 90%

9. Which of the following causes both sensible and latent heat gain?
   a) Equipment
   b) Motors
   c) People
   d) Appliances

10. CTS stands for:
    a) Conduction Time Series
    b) Convection Time Series

c) Commercial time series
d) none of the above

Section – B

04X04 = 16 Marks

1. What are the different types of heat gains?
2. What is a thermal envelope for a building?
3. Give an overview of RTSM method?
4. What is heat balance method and how is it different from RTSM?

Section – C

04X06 = 24 Marks

1. A 200 seat school band room is used continuously from 10 am until 6:00pm each day. For the first four hours, it is at 50% capacity; during the last two hours, it is at 80% capacity. Estimate the sensible heat gain from people at 12 pm, 2:00 pm, 4:00 pm and 6:00 pm.

2. What is combined convection and radiation.
3. How is the U value for a wall is calculated

What is effective leakage area method?

Cooling Load Factors for People and Unhooded Equipment[1]

Hours in Space	Number of Hours after Entry into Space or Equipment Turned On																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Zone Type A																								
2	0.75	0.88	0.18	0.08	0.04	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.75	0.88	0.93	0.95	0.22	0.10	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.75	0.88	0.93	0.95	0.97	0.97	0.23	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.75	0.88	0.93	0.95	0.97	0.97	0.98	0.98	0.24	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
10	0.75	0.88	0.93	0.95	0.97	0.97	0.98	0.98	0.99	0.99	0.24	0.12	0.07	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00
12	0.75	0.88	0.93	0.96	0.97	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.25	0.12	0.07	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01
14	0.76	0.88	0.93	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03	0.02	0.02	0.01	0.01
16	0.76	0.89	0.94	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03	0.02	0.02
18	0.77	0.89	0.94	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.12	0.07	0.05	0.03	0.03
Zone Type B																								
2	0.65	0.74	0.16	0.11	0.08	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.65	0.75	0.81	0.85	0.24	0.17	0.13	0.10	0.07	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
6	0.65	0.75	0.81	0.85	0.89	0.91	0.29	0.20	0.15	0.12	0.09	0.07	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00
8	0.65	0.75	0.81	0.85	0.89	0.91	0.93	0.95	0.31	0.22	0.17	0.13	0.10	0.08	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01
10	0.65	0.75	0.81	0.85	0.89	0.91	0.93	0.95	0.96	0.97	0.33	0.24	0.18	0.14	0.11	0.08	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01
12	0.66	0.76	0.81	0.86	0.89	0.92	0.94	0.95	0.96	0.97	0.98	0.98	0.34	0.24	0.19	0.14	0.11	0.08	0.06	0.05	0.04	0.03	0.02	0.02
14	0.67	0.76	0.82	0.86	0.89	0.92	0.94	0.95	0.96	0.97	0.98	0.98	0.99	0.99	0.35	0.25	0.19	0.15	0.11	0.09	0.07	0.05	0.04	0.03
16	0.69	0.78	0.83	0.87	0.90	0.92	0.94	0.95	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.35	0.25	0.19	0.15	0.11	0.09	0.07	0.05
18	0.71	0.80	0.85	0.88	0.91	0.93	0.95	0.96	0.97	0.98	0.98	0.99	0.99	0.99	0.99	0.99	1.00	1.00	0.35	0.25	0.19	0.15	0.11	0.09
Zone Type C																								
2	0.60	0.68	0.14	0.11	0.09	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
4	0.60	0.68	0.74	0.79	0.23	0.18	0.14	0.12	0.10	0.08	0.06	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
6	0.61	0.69	0.74	0.79	0.83	0.86	0.28	0.22	0.18	0.15	0.12	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.01
8	0.61	0.69	0.75	0.79	0.83	0.86	0.89	0.91	0.32	0.26	0.21	0.17	0.14	0.11	0.09	0.08	0.06	0.05	0.04	0.04	0.03	0.02	0.02	0.02
10	0.62	0.70	0.75	0.80	0.83	0.86	0.89	0.91	0.92	0.94	0.35	0.28	0.23	0.18	0.15	0.12	0.10	0.08	0.07	0.06	0.05	0.04	0.03	0.03
12	0.63	0.71	0.76	0.81	0.84	0.87	0.89	0.91	0.93	0.94	0.95	0.96	0.37	0.29	0.24	0.19	0.16	0.13	0.11	0.09	0.07	0.06	0.05	0.04
14	0.65	0.72	0.77	0.82	0.85	0.88	0.90	0.92	0.93	0.94	0.95	0.96	0.97	0.97	0.38	0.30	0.25	0.20	0.17	0.14	0.11	0.09	0.08	0.06
16	0.68	0.74	0.79	0.83	0.86	0.89	0.91	0.92	0.94	0.95	0.96	0.96	0.97	0.98	0.98	0.98	0.39	0.31	0.25	0.21	0.17	0.14	0.11	0.09
18	0.72	0.78	0.82	0.85	0.88	0.90	0.92	0.93	0.94	0.95	0.96	0.97	0.97	0.98	0.98	0.99	0.99	0.99	0.39	0.31	0.26	0.21	0.17	0.14
Zone Type D																								
2	0.59	0.67	0.13	0.09	0.08	0.06	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
4	0.60	0.67	0.72	0.76	0.20	0.16	0.13	0.11	0.10	0.08	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.01
6	0.61	0.68	0.73	0.77	0.80	0.83	0.26	0.20	0.17	0.15	0.13	0.11	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.02
8	0.62	0.69	0.74	0.77	0.80	0.83	0.85	0.87	0.30	0.24	0.20	0.17	0.15	0.13	0.11	0.10	0.08	0.07	0.06	0.05	0.05	0.04	0.04	0.03
10	0.63	0.70	0.75	0.78	0.81	0.84	0.86	0.88	0.89	0.91	0.33	0.27	0.22	0.19	0.17	0.14	0.12	0.11	0.09	0.08	0.07	0.06	0.05	0.05
12	0.65	0.71	0.76	0.79	0.82	0.84	0.87	0.88	0.90	0.91	0.92	0.93	0.35	0.29	0.24	0.21	0.18	0.16	0.13	0.12	0.10	0.09	0.08	0.07
14	0.67	0.73	0.78	0.81	0.83	0.86	0.88	0.89	0.91	0.92	0.93	0.94	0.95	0.95	0.37	0.30	0.25	0.22	0.19	0.16	0.14	0.12	0.11	0.09
16	0.70	0.76	0.80	0.83	0.85	0.87	0.89	0.90	0.92	0.93	0.94	0.95	0.95	0.96	0.96	0.97	0.38	0.31	0.26	0.23	0.20	0.17	0.15	0.13
18	0.74	0.80	0.83	0.85	0.87	0.89	0.91	0.92	0.93	0.94	0.95	0.95	0.96	0.97	0.97	0.97	0.98	0.98	0.39	0.32	0.27	0.23	0.20	0.17

Heat Gain From Occupants of Conditioned Spaces[1]

Degree of Activity		Total Heat, Btu/h: Adult Male	Total Heat, Btu/h: Adjusted, M/F[a]	Sensible Heat, Btu/h	Latent Heat, Btu/h	% Sensible Heat that is Radiant[b]: Low V	% Sensible Heat that is Radiant[b]: High V
Seated at theater	Theater, matinee	390	330	225	105		
Seated at theater, night	Theater, night	390	350	245	105	60	27
Seated, very light work	Offices, hotels, apartments	450	400	245	155		
Moderately active office work	Offices, hotels, apartments	475	450	250	200		
Standing, light work; walking	Department store; retail store	550	450	250	200	58	38
Walking, standing	Drug store, bank	550	500	250	250		
Sedentary work	Restaurant[c]	490	550	275	275		
Light bench work	Factory	800	750	275	475		
Moderate dancing	Dance hall	900	850	305	545	49	35
Walking 3 mph; light machine work	Factory	1000	1000	375	625		
Bowling[d]	Bowling alley	1500	1450	580	870		
Heavy work	Factory	1500	1450	580	870	54	19
Heavy machine work; lifting	Factory	1600	1600	635	965		
Athletics	Gymnasium	2000	1800	710	1090		

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School of RAC Skills

Session: 2020-21 (Summer Semester)

B. Voc. 5th Semester

End-Sem. Examination

Course Code: HVA1501 **Time: 2 Hours**

Course Name: Heat Load Estimation **Max. Marks: 50**

Instruction: Attempt all questions

Calculator is allowed

Answer key

SET-A

Section – A

10X01 = 10 Marks

1. D
2. C
3. A
4. C
5. D
6. A
7. B
8. C
9. C
10. A

Section – B

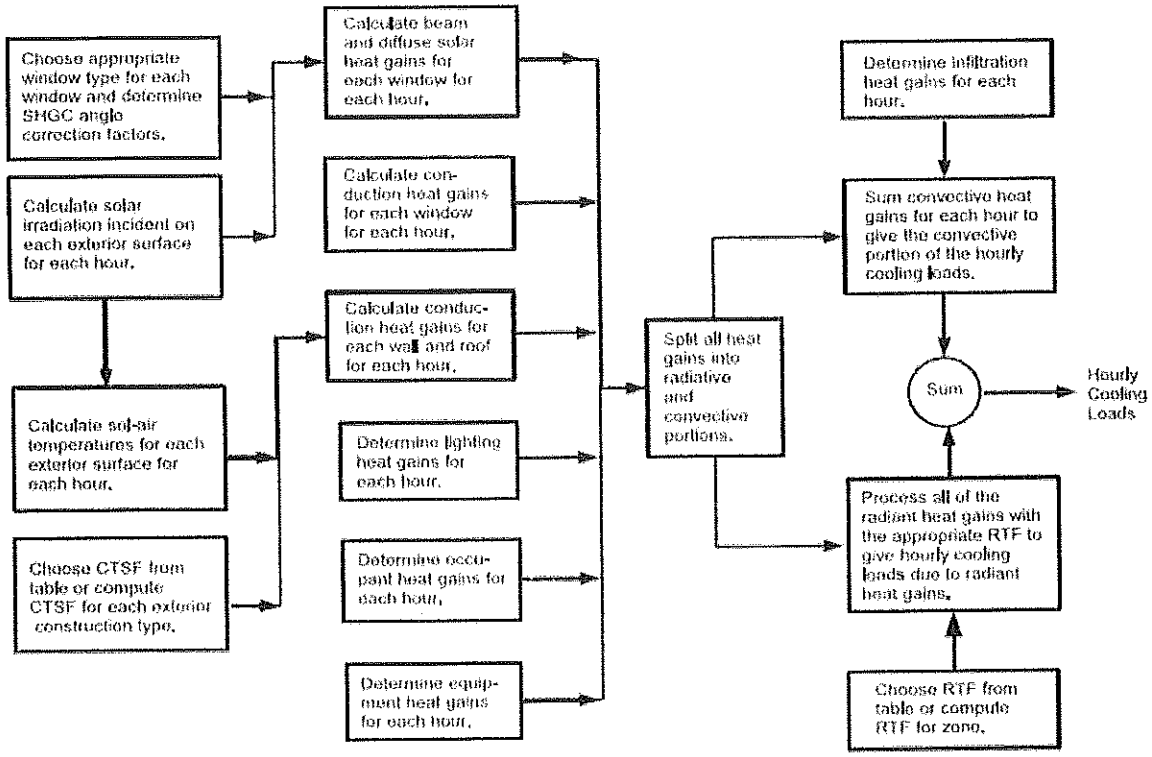
04X04 = 16 Marks

1. Transmission
   Internal gains
   Solar gains
   Air leakge
2. Separates interior and exterior of a building

   Floor
   Foundation
   Walls
   Ceiling
   Roof

Components that penetrate the building

Windows
Doors
Vents
Electrical Boxes
Pipes



4. The RTSM was developed to be rigorous, without requiring iteration (as does the HBM) to determine conduction heat gains and cooling loads. The RTSM produces individual component heat gains and cooling loads that can be readily examined by the designer. In addition, the coefficients that are used to compute transient conduction heat gain and cooling loads have a physical meaning that can be understood by the user of the method. These characteristics allow the use of engineering judgment during the cooling load calculation process.

Section – C

04X06 = 24 Marks

Assuming the walls are concrete block with few windows and the floor is not carpeted, this could be a zone type C construction. The activity level might best be described as sedentary work, comparable to a restaurant. the total adjusted heat gain per person is 275 Btu/h sensible and 275 Btu/h latent. The CLF and sensible cooling loads are shown in

People	Heat Gain (each)	Hours/ Day	Start Time	CLF at 2:00	CLF at 4:00	CLF at 6:00	Cooling Load at 2:00	Cooling Load at 4:00	Cooling Load at 6:00
50	275	4	12:00	0.68	0.79	0.18	9350	10863	2475
30	275	2	2:00	0	0.68	0.11	0	5610	908
	275	(Latent)					13750	0	0
Sensible Total, Btu/h							9350	16473	3383
Latent Total, Btu/h							13750	0	0

thetable below. At 2:00 pm, there are 50 people in the room, with another 30 just entering. The energy the new class generates will not occur until 3:00 pm. Note that the latent load is always an instantaneous load.

2. Convection and radiation analysis are often combined into a single surface conductance. This requires a linear approximation of the radiation heat transfer. Considering the surface 2 in Radiation Equation could represent, in aggregate, the surroundings, then approximately (therefore $A_2 >> A_1$) and can be simplified to

$$\dot{q}_{1-2} = A_1 \varepsilon_1 \sigma (T_1^4 - T_2^4) = A_1 h_r (T_1 - T_2)$$

The combined convection and radiation heat transfer rate to be expressed as:

$$\dot{q} = h_o A (t - t_w)$$

3. The U-factor is more commonly used to describe thermal conductivity in HVACR load calculations

A U-factor is assigned for a material of a given thickness

- For example 2" foam board has an u-factor of .1

The smaller the U-factor the lower the conductivity and the higher the R value The rate of heat loss via conduction for a given building panel is calculated by the

formula: Q = U-factor x Area x Δt

Or just: Q = U x A x Δt

In the previous problem Q = 0.2 x 200 x 60

Q = 2400 Btu/h

The second method to determine the rate of air infiltration is based on the effective leakage area of various construction components used in both residential and commercial buildings.

- To obtain the building's total leakage area, multiply the overall dimensions or number of occurrences of each building component by the Leakage related to them.
- Using the effective leakage area, the air flow rate due to infiltration is calculated according to:

where,

$$Q = L\left(A\Delta T + BV^2\right)^{0.5}$$

Q = air flow rate, cfm
L = effective leakage area, in.^{2}
A = stack effect coefficient, cfm^2/(in.^{4}·°F)
ΔT = average indoor-outdoor temperature difference, °F
B = wind coefficient, cfm^2/(in.^{4}·mph^2)
V = average wind speed, mph

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B. Voc. 5th Semester

End-Sem. Examination

Time: 2 Hours

Max. Marks: 50

Course Code: HVA1501

Course Name: Heat Load Estimation

Instruction: Attempt all questions

Calculator is allowed

SET-B

Section – A

10X01 = 10 Marks

1. _____ is the process of mechanically moving air through building through an air handler system to the rooms.

   a) Ventilation b) Purification c) Circulation d) None of the above

2. Each person at rest will give off about____BTUs.
   a) 500
   b) 300
   c) 100
   d) 200

3. Which of the following is not a part of building envelope –
   a) Floor
   b) Walls
   c) Electrical Boxes
   d) Roof

4. Which of the following is not an envelope problem:
   a) Spalling
   b) Cracking
   c) Effloscence
   d) Reflectance

5. Which of the following is not an infiltration method:
   a)Air change method
   b)Effective leakage area Method
   c)Ventilation method
   d)None of the above

6. Poorly designed or installed systems can have leakage rates of
   a) 50%to60% b) 70%-80% c) 20%-40% d) 10% to 30%.

7. Temperature affiliated to solar irradiation is called:
   a) Air temperature b) Irradiation temperature c) sol-air temperature d) none of the above

8. Stacking is caused by:
   a) Exfiltration
   b) Infiltration
   c) Pressure difference
   d) All of the above

9. Which of the following Law's determine intensity
   a) Planck's Law
   b) Charles Law
   c) Boyle's Law
   d) none of the above

10. RTSM stands for:
    a) Radiant Time Series method
    b) Radiation Time Series method

c) Refraction time series method
d) none of the above

Section – B

04X04 = 16 Marks

1. What are impacts of building envelope?
2. What are human requirements for buildings?
3. What is Infiltration gain?
4. What is view factor? Explain with diagram

Section – C

04X06 = 24 Marks

1. A shop owner is considering replacing the shop's present fluorescent fixtures (90 bulbs at 35 W each with magnetic ballast) with either new T-8 lamps (with electronic ballast) or 5000 W of incandescent bulbs to highlight the products. The shop is open from 8:00am until 9:00pm, seven days per week. Determine the sensible heat gain at 10:00 am, 3:00pm and 8:00pm for all three scenarios. Use this data to discuss briefly how each might affect the cooling load on the space, and make a recommendation to the owner from a thermal system design perspective.
2. What is wind and stack effects? Explain.
3. What are the cooling system gains?

14. What are conductive heat gains from opaque surfaces

Cooling Load Factors for Lights[1]

Lights On For	Number of Hours after Lights Turned On																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Zone Type A																								
8	0.85	0.92	0.95	0.96	0.97	0.97	0.97	0.98	0.13	0.06	0.04	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10	0.85	0.93	0.95	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.14	0.07	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
12	0.86	0.93	0.96	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.14	0.07	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
14	0.86	0.93	0.96	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.15	0.07	0.05	0.03	0.03	0.03	0.02	0.02	0.02	0.02
16	0.87	0.94	0.96	0.97	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.15	0.08	0.05	0.04	0.03	0.03	0.03	0.02
Zone Type B																								
8	0.75	0.85	0.90	0.93	0.94	0.95	0.95	0.96	0.23	0.12	0.08	0.05	0.04	0.04	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01
10	0.75	0.86	0.91	0.93	0.94	0.95	0.95	0.96	0.96	0.97	0.24	0.13	0.08	0.06	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.02
12	0.76	0.86	0.91	0.93	0.95	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.24	0.14	0.09	0.07	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.03
14	0.76	0.87	0.92	0.94	0.95	0.96	0.96	0.97	0.97	0.97	0.97	0.98	0.98	0.98	0.25	0.14	0.09	0.07	0.06	0.05	0.05	0.04	0.04	0.03
16	0.77	0.88	0.92	0.95	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.25	0.15	0.10	0.07	0.06	0.05	0.05	0.04
Zone Type C																								
8	0.72	0.80	0.84	0.87	0.88	0.89	0.90	0.91	0.23	0.15	0.11	0.09	0.08	0.07	0.07	0.06	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.03
10	0.73	0.81	0.85	0.87	0.89	0.90	0.91	0.92	0.92	0.93	0.25	0.16	0.13	0.11	0.09	0.08	0.08	0.07	0.06	0.06	0.05	0.04	0.04	0.04
12	0.74	0.82	0.86	0.88	0.90	0.91	0.92	0.92	0.93	0.94	0.94	0.95	0.26	0.18	0.14	0.12	0.10	0.09	0.08	0.08	0.07	0.06	0.06	0.05
14	0.75	0.84	0.87	0.89	0.91	0.92	0.92	0.93	0.94	0.94	0.95	0.95	0.96	0.96	0.27	0.19	0.15	0.13	0.11	0.10	0.09	0.08	0.08	0.07
16	0.77	0.85	0.89	0.91	0.92	0.93	0.93	0.94	0.95	0.95	0.95	0.96	0.96	0.97	0.97	0.97	0.28	0.20	0.16	0.13	0.12	0.11	0.10	0.09
Zone Type D																								
8	0.66	0.72	0.76	0.79	0.81	0.83	0.85	0.86	0.25	0.20	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.05	0.04	0.04
10	0.68	0.74	0.77	0.80	0.82	0.84	0.86	0.87	0.88	0.90	0.28	0.23	0.19	0.17	0.15	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.06
12	0.70	0.75	0.79	0.81	0.83	0.85	0.87	0.88	0.89	0.90	0.91	0.92	0.30	0.25	0.21	0.19	0.17	0.15	0.13	0.12	0.11	0.10	0.09	0.08
14	0.72	0.77	0.81	0.83	0.85	0.86	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.94	0.32	0.26	0.23	0.20	0.18	0.16	0.14	0.13	0.12	0.10
16	0.75	0.80	0.83	0.85	0.87	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.94	0.95	0.96	0.96	0.34	0.28	0.24	0.21	0.19	0.17	0.15	0.14

Zone Types for Use With SCL and CLF Tables, Single-Story Building[2]

Zone Parameters*				Zone Type		
No. Walls	Floor Covering	Partition Type	Inside Shade	Glass Solar	People and Equipment	Ligl
1 or 2	Carpet	Gypsum	b	A	B	B
1 or 2	Carpet	Concrete block	b	B	C	C
1 or 2	Vinyl	Gypsum	Full	B	C	C
1 or 2	Vinyl	Gypsum	Half to None	C	C	C
1 or 2	Vinyl	Concrete block	Full	C	D	D
1 or 2	Vinyl	Concrete block	Half to None	D	D	D
3	Carpet	Gypsum	b	A	B	B
3	Carpet	Concrete block	Full	A	B	B
3	Carpet	Concrete block	Half to None	B	B	B
3	Vinyl	Gypsum	Full	B	C	C
3	Vinyl	Gypsum	Half to None	C	C	C
3	Vinyl	Concrete block	Full	B	C	C
3	Vinyl	Concrete block	Half to None	C	C	C
4	Carpet	Gypsum	b	A	B	B
4	Vinyl	Gypsum	Full	B	C	C
4	Vinyl	Gypsum	Half to None	C	C	C

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of RAC Skills

Session: 2020-21 (Summer Semester)

B. Voc. 5th Semester

End-Sem. Examination

Course Code: HVA-1501 **Time: 2 Hours**

Course Name: Heat Load Estimation **Max. Marks: 50**

Instruction: Attempt all questions

SET-B

Section – A

10X01 = 10 Marks

1. A
2. B
3. C
4. D
5. C
6. D
7. C
8. D
9. A
10. A

Section – B

04X04 = 16 Marks

1. Barrier between conditioned inside air and unconditioned outside air

- Significant impact on passive heat lost and gained by the building
- Passive heat transfer increases the load on the HVAC system

2. Sensitivity to thermal changes and air movements

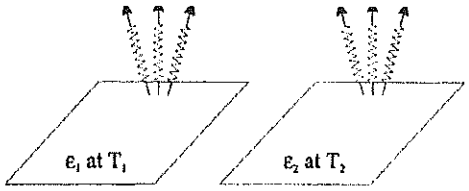
Sensitivity to vibrations and noise

Problems of vision, within a building and looking out from a building
Social aspects and location

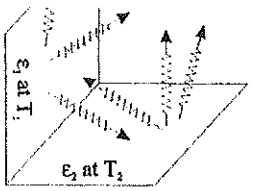
Safety

3. Air can enter the home by means of bypasses in areas such as Windows, doors, fireplaces, and vent pipes. Today many homes are being built to reduce infiltration by sealing off any bypasses that can be located. During the winter when the temperature outdoors can be extremely low the likelihood of infiltration increases. When the outdoor ambient is low, heat rises to the ceiling and can leave the home through vents and light fixtures. This exfiltration will cause infiltration to increase; therefore the winter can be the worst-case scenario for home inefficiencies. Summer has the lowest amounts of infiltration because of these reasons but the solar gains from the sun will increase.

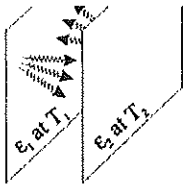
4. The effect of view angle between the energy source and receiver is shown.
   - As the angle between the hot surface and cold surface decreases, more of the available energy is transferred between the two plates. The maximum radiant heat transfer occurs when the two plates are parallel.
   - This geometry frequently occurs in buildings (double-pane glazings, hollow core walls, suspended ceilings and roofs, etc.).



No Radiant Transfer
(Surfaces are in same plane)



Some Radiant Transfer
(Surfaces intersect)



Maximum Radiant Transfer
(Surfaces are parallel)

Section – C

04X06 = 24 Marks

1. The indicated zone type is B. The total installed wattage is 90 (bulbs)·35W/ bulb)= 3150 W.

- The use factor is 1.0 (all lights are on) and the special allowance factor is 1.2.
- The CLF from Table for zone type B, for 10 am after being turned on is 0.95. The values at 3 pm and 8 pm are 0.96 and 0.12, respectively. Therefore the sensible heat gains will be 3150 *0.95*1.2*3.41
- 0.96 and 0.12 correction factor will also be used.

2. The prevailing wind causes a high pressure on one side of the structure and a slight negative pressure on the opposite side.

- These two different pressures combine to force air into any opening on the upwind side and to pull air out of the building on the downwind side
- . These openings can be very difficult to locate and control, but are often found where building materials change (for example, at the sole plate in a frame building and around doors and windows) and at service entrances (electric, water and telephone).
- The second driving force causing infiltration is natural draft, or the stack effect.
- Hot air rises through the building and escapes through cracks in the top ceiling. This causes cold outside air to be drawn in low (around the sole plate, basement windows or crawlspace access).
- While some outside air is necessary for fired equipment that is usually located in the basement (dryer, water heater, furnace, etc.), it is better to provide this air directly to the mechanical room.
- This helps to reduce drafts in the building caused by these devices. This stack effect becomes very pronounced in high-rise buildings, often causing noisy elevator and stair doors, where air is drawn into (or out of) these vertical shafts.

3. The final internal heat source that must be considered as part of the cooling load calculation is the cooling system itself. Losses from the supply air fan, motor and drive system can contribute to the space cooling load. Heat transfer through the ductwork and air flow losses (or gains) due to leakage can be significant and must be accounted for in the cooling load estimate. Typical fan efficiencies range between 50% and 70%, with an average value of 65%. Thus 35% of the energy required by the fan appears as instantaneous heat gain to the air being transported. Depending on the static pressure and system air flow rate, this will result in a slight (often less than 1 °F) rise in the air temperature. Depending on the type of system installed, this heat gain will affect the system differently. For example, if the fan is in front of the cooling coil (blow-through), then the coil will remove the energy immediately, but the space load will be unaffected. However, when the fan is after the cooling coil (drawthrough), these losses become heat gains to the system. Either the supply air temperature must be reduced slightly, or the air flow through the system must be increased slightly to compensate for this energy gain.

4. Conductive heat gain is calculated for each wall and roof type with the use of a conduction time series (CTS). The 24 coefficients of the CTS are periodic response factors referred to as conduction time series factors (CTSFs). This formulation gives a time series solution to the transient, periodic, one-dimensional conductive heat transfer problem. For any hour, , the conductive heat gain for the surface is given by the summation of the CTSFs multiplied by the UA value multiplied by the temperature difference across the surface, given by

$$q_\theta = \sum_{j=0}^{23} c_j UA(t_{e,\theta - j\delta} - t_{rc})$$

Which could be written as :

where

q_θ = hourly conductive heat gain, Btu/h, for the surface
U = overall heat transfer coefficient for the surface, Btu/h·ft^2·°F
A = surface area, ft^2
c_j = j^{th} conduction time series factor
$t_{e,\theta - j\delta}$ = sol-air temperature, °F, j hours ago
t_{rc} = presumed constant room air temperature, °F
θ = the current hour
δ = the time step (one hour)

$$q_\theta = c_0 UA(t_{e,\theta} - t_{rc}) + c_1 UA(t_{e,\theta-\delta} - t_{rc}) + c_2 UA(t_{e,\theta-2\delta} - t_{rc}) + \ldots + c_{23} UA(t_{e,\theta-23\delta} - t_{rc})$$

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Time: **2 Hours**

Course Code: HVA1502

Max. Marks: 50

Course Name: Cold Chain & Cold Storage

SET-A

Instruction:

All questions are compulsory.

Section A is objective type.

Section B is short answer type.

Section C is long answer type.

Section – A

10X01 = 10 Marks

1. Fats in frozen fish tissue tend to become rancid quicker than fats in frozen animal tissues.
   a. True
   b. FalseProvide customer satisfaction
   c. Improve quality of a product
   d. None of the above

2. Pork has a higher shelf life than beef.
   a. True
   b. False
   c. Not Comparable
   d. Services

3. Which of the following nutrients are lost in all steps of food engineering (including packaging and freezing)?
   a. Minerals
   b. Vitamins
   c. Fats
   d. Proteins

4. Evaporation, desiccation and dehydration all mean the same thing.
   a. True
   b. False
   c. Both
   d. None of the above

5. The length of storage of fruits and vegetables is a function of _____
   a. Resistance to attack by microorganisms
   b. Composition
   c. Gases in the environment
   d. All of the mentioned

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6. Psychrometry is the study of-

   a. moist air
   b. stasis point
   c. metrics in Canada
   d. none of the above

7. At 100% relative humidity, the wet bulb temperature is-

   a. lower than the dew point temperature
   b. higher than the dew point temperature
   c. equal to the dew point temperature
   d. none of the above

8. The horizontal line in psychrometric chart joining the change of state of air represents
   a. humidification
   b. sensible cooling or heating
   c. sensible cooling or heating with humidification
   d. sensible cooling or heating with dehumidification

9. Which of the following are Milk Processing Operations?

   a. Clarification
   b. Pasteurization
   c. Homogenization
   d. All of the mentioned

10. Which of the following is true about fruits and vegetable processing?
   a. They get spoil very fast and hence need to be consumed soon
   b. They have high moisture content and should be kept in a cold, dark place
   c. They're tender and hence get spoiled easily
   d. All of the mentioned

Section – B

04X04 = 16 Marks

1. Explain postharvest physiology of fruits and vegetables through neat sketch.
2. Write down the importance of food preservation.
3. How multistage compressors are useful than single stage compressors?
4. Write a short note on cold store doors.

Section – C

04X06 = 24 Marks

1. Write down the advantages of forced draft cooling towers.
2. Explain Drive-in drive-through pallet racking
3. What are the expansion devices? Explain the different types of it.
4. 39.6 m3 /min of a mixture of re-circulated room air and outdoor air enters cooling coil at 31°C dry bulb temperature and 18.5°C wet bulb temperature. The effective surface temperature of the coil is 4.4°C. The surface area of the coil is such as would give 12.5 kW of refrigeration with the given entering air state. Determine the dry and wet bulb temperatures of the air leaving the coil and the by-pass factor.

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Course Code: HVA1502 Time: **2 Hours**

Course Name: Cold Chain & Cold Storage Max. Marks: 50

ANSWER KEY -A

Instruction:

All questions are compulsory.

Section A is objective type.

Section B is short answer type.

Section C is long answer type.

Section – A

10X01 = 10 Marks

1. Fats in frozen fish tissue tend to become rancid quicker than fats in frozen animal tissues.
   a. True

2. Pork has a higher shelf life than beef.
   b. False

3. Which of the following nutrients are lost in all steps of food engineering (including packaging and freezing)?
   b. Vitamins

4. Evaporation, desiccation and dehydration all mean the same thing.
   b. False

5. The length of storage of fruits and vegetables is a function of _____
   d. All of the mentioned

6. Psychrometry is the study of-
   a. moist air

7. At 100% relative humidity, the wet bulb temperature is-
   c. equal to the dew point temperature

8. The horizontal line in psychrometric chart joining the change of state of air represents
   b. sensible cooling or heating

9. Which of the following are Milk Processing Operations?
   d. All of the mentioned

10. Which of the following is true about fruits and vegetable processing?
    d. All of the mentioned

Section – B

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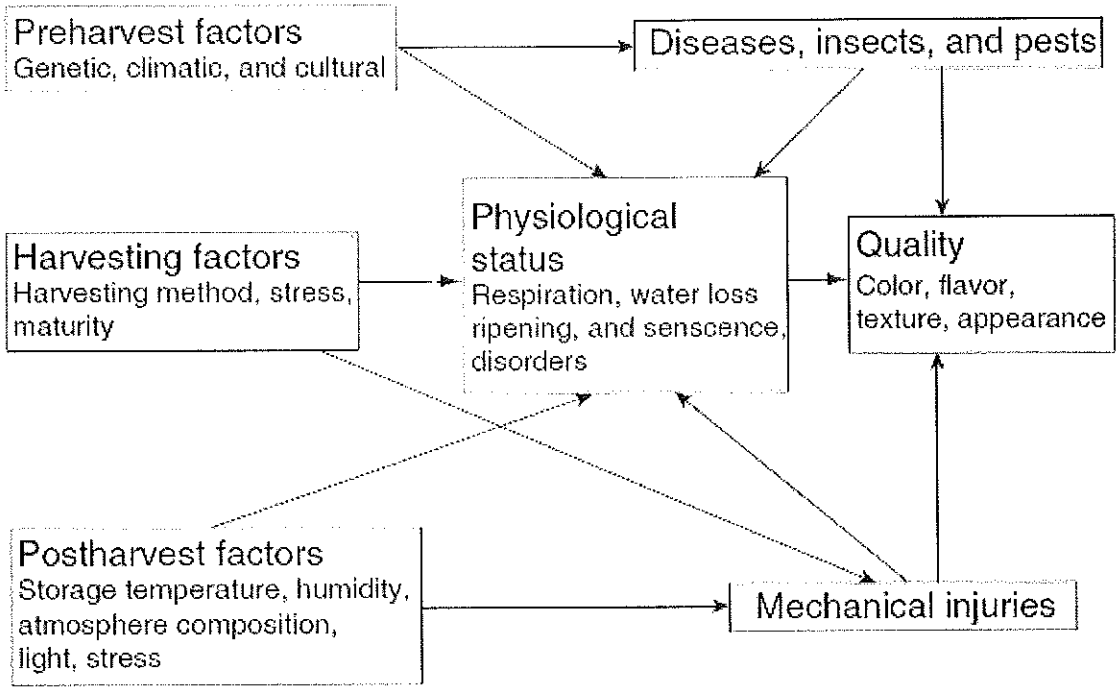
04X04 = 16 Marks

1. Explain postharvest physiology of fruits and vegetables through neat sketch.



2. Write down the importance of food preservation.

Answer: The main reasons for food preservation are to overcome inappropriate planning in agriculture, produce value-added products, and provide variation in diet. The agricultural industry produces raw food materials in different sectors. Inadequate management or improper planning in agricultural production can be overcome by avoiding inappropriate areas, times, and amounts of raw food materials as well as by increasing storage life using simple methods of preservation. Value-added food products can give better-quality foods in terms of improved nutritional, functional, convenience, and sensory properties. Consumer demand for healthier and more convenient foods also affects the way food is preserved. Eating should be pleasurable to the consumer, and not boring. particularly in underdeveloped countries to reduce reliance on a specific type of grain (i.e., rice or wheat).

3. How multistage compressors are useful than single stage compressors?

When the compression ratio required is considerably high, as in the case of low temperature refrigeration systems, the single-stage compression is highly uneconomical due to the following reasons.

1. Very low volumetric efficiency
2. High frictional losses

3. Leakage problems

4. High running cost

In multistage compression, the compression of refrigerant from initial pressure to final pressure is carried out in more than one cylinder. A multistage compression with intermediate cooling is generally adopted for economical working.

4. Write a short note on cold store doors.

When choosing a door system the following should be considered

- Is the track designed to give a good positive sealing action without undue wear to the sealing gaskets and will it be strong enough for its usage?
- Does it allow the door to be adjusted easily and accurately in all directions?
- Are the runners durable and will they allow free running?
- Will the handles, both inside and outside, allow easy opening of the door?
- Can the system be locked and does it have an emergency release facility?
- Do the moving parts require little maintenance and can they be easily replaced in the event of damage?

Section – C

04X06 = 24 Marks

1. Write down the advantages of forced draft cooling towers.

Answer:

1. Forced draft (FD) towers are more efficient than ID draft because some of the air velocity is converted into static pressure in the tower and recovered in the form of useful work.
2. The vibration and noise are minimal because mechanical equipment is set on solid foundations.
3. Because it handles dry air, problems of blade erosion are avoided.
4. It is safer because it is located on the ground level.

2. Explain Drive-in drive-through pallet racking

Answer: This system uses a form of racking which allows each pallet to be supported individually but gives a similar cube utilization to block stacking. Drive-in dictates that the loads stored will be last in, first out (LIFO). Drive-through enables a first in, first out (FIFO) operation to take place. The system generally uses racking uprights fitted with pallet support rails cantilevered from the side of the uprights (Figure 9.11). These rails run from front to rear and form the required storage levels. The uprights

are fixed to the floor and tied above the top pallet level. The structure is also braced above the top pallet level. Lanes are therefore formed down which a truck can be driven to access each level of pallets. All levels in each lane have to be filled or emptied at the same time, which, in turn, means that each lane must contain the same product. The difference between drive-in and drive-through is that with drive-in each block can only be accessed from one side, whereas drive-through can be accessed from both sides with no structural impediments in any of the lanes. As drive-through usually requires a higher level of strength to be derived from the steelwork above the top pallet, it is therefore less cost effective than drive-in. A simple solution is to place two drive-in installations back to back when access is required from both sides and FIFO is not important.

3. What are the expansion devices? Explain the different types of it.

An expansion device in a refrigeration system normally serves two purposes. One is the thermodynamic function of expanding the liquid refrigerant from the condenser pressure to the evaporator pressure. The other is the control function, which may involve supply of the liquid to the evaporator at the rate of which it is evaporated.

The different devices that are used to perform these functions include the following:

1. Capillary tube
2. Pressure control or automatic expansion valve
3. Thermostatic expansion valve
4. High-side float valve
5. Low-side float valve

4. 39.6 m3 /min of a mixture of re-circulated room air and outdoor air enters cooling coil at 31°C dry bulb temperature and 18.5°C wet bulb temperature. The effective surface temperature of the coil is 4.4°C. The surface area of the coil is such as would give 12.5 kW of refrigeration with the given entering air state. Determine the dry and wet bulb temperatures of the air leaving the coil and the by-pass factor.

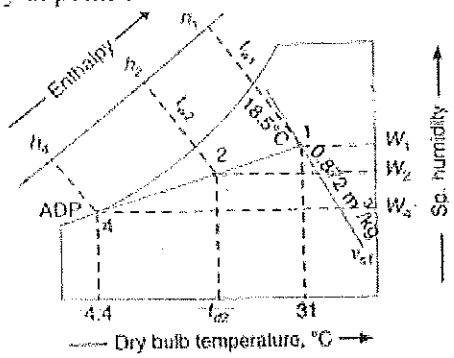
Solution: Given: v1= 39.6 m3 /min; tdt = 31°C; twt = I8.5°C; ADP= td4= 4.4°C; Q= 12.5 kW = 12.5 kJ/s = 12.5 x 60 kJ/min

Dry and wet bulb temperature of the air leaving the coil Let td2 and tw2 = Dry and wet bulb temperature of the air leaving the coil. First of all, mark the initial condition of air, i.e. 31°C dry bulb temperature and 18.5°C wet bulb temperature on the psychrometric chart at point

1, as shown in Fig. Now mark the effective surface temperature (ADP) of the coil at 4.4°C at point 4.

From the psychrometric chart, we find that enthalpy at point 1

$$h_1 = 52.5 \text{ kJ / kg of dry air}$$



Enthalpy at point 4,

$$h_4 = 17.7 \text{kJ/kg of dry air}$$

Specific humidity at point 1

$$W_1 = 0.0082 \text{ kg / kg of dry air}$$

Specific humidity at point 4,

$$W_4 = 0.00525 \text{ kg / kg of dry air}$$

Specific volume at point

$$v_{s1} = 0.872 \text{m}^3\text{/ kg}$$

We know that mass flow rate of dry air at point 1,

$$m_a = \frac{v_1}{v_{s1}} = \frac{39.6}{0.872} = 44.41 \text{ kg/min}$$

and cooling capacity of the coil,

$$Q = m_a (h_1 - h_2)$$

or

$$h_1 - h_2 = \frac{Q}{m_a} = \frac{12.5 \times 60}{44.41} = 16.89 \text{ kJ / kg of dry air}$$

$$\therefore \quad h_2 = h_1 - 16.89 = 52.5 - 16.89 = 35.61 \text{ kJ / kg of dry air}$$

The equation for the condition line 1–2–4 is given as

$$\frac{W_2 - W_4}{W_1 - W_4} = \frac{h_2 - h_4}{h_1 - h_4}$$

$$\frac{W_2 - 0.005\,25}{0.0082 - 0.005\,25} = \frac{35.61 - 17.7}{52.5 - 17.7}$$

$$\therefore \quad W_2 = 0.006\,77 \text{ kg / kg of dry air}$$

Now plot point 2 on the psychrometric chart such as enthalpy, $h_2 = 35.61$ kJ/kg of dry air and specific humidity, $W_2 = 0.00677$ kg/kg of dry air. At point 2, we find that

$$t_{d2} = 18.5°\text{C}; \text{ and } t_{w2} = 12.5°\text{C Ans.}$$

By-pass factor

We know that by-pass factor,

$$BPF = \frac{h_2 - h_4}{h_1 - h_4} = \frac{35.61 - 17.7}{52.5 - 17.7} = 0.5146 \text{ Ans.}$$

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Time: **2 Hours**

Course Code: HVA1502

Max. Marks: 50

Course Name: Cold Chain & Cold Storage

SET-B

Instruction:

All questions are compulsory.

Section A is objective type.

Section B is short answer type.

Section C is long answer type.

Section – A

10X01 = 10 Marks

1. Keeping in mind that texture changes take place after harvest, pulpy fruits become extremely hard after harvest.

a. True
b. False
c. Mixed
d. None of the above

2 After harvest, _____ of fruits and vegetables undergoes change.

a. Texture, nutrients, minerals
b. Color, minerals, nutrients
c. Texture, minerals, nutrients
d. None of the mentioned

3 Which of the following is true about fruits and vegetable processing?

a. They get spoil very fast and hence need to be consumed soon
b. They have high moisture content and should be kept in a cold, dark place
c. They're tender and hence get spoiled easily
d. All of the mentioned

4 Which of the following is not related to Post Harvest losses?

a. Postharvest losses can be reduced by adding value to products
b. Packaging, storage, transportation areas are where losses take place
c. Farmers don't earn much after adding value to products
d. Value can be added to products by converting raw form into a more processed/refined form

5. Which of the following are Milk Processing Operations?

a. Clarification
b. Pasteurization
c. Homogenization
d. All of the mentioned

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

6. Which of the following nutrients are lost in all steps of food engineering (including packaging and freezing)?
   a. Minerals
   b. Vitamins
   c. Fats
   d. Proteins

7. At 100% relative humidity, the wet bulb temperature is-
   a. lower than the dew point temperature
   b. higher than the dew point temperature
   c. equal to the dew point temperature
   d. none of the above

8. The horizontal line in psychrometric chart joining the change of state of air represents
   a. humidification
   b. sensible cooling or heating
   c. sensible cooling or heating with humidification
   d. sensible cooling or heating with dehumidification

9. Pork has a higher shelf life than beef.
   a. True
   b. False
   c. Not Comparable
   d. Services

10. It is possible to maintain conditions of temperature and pressure whereby the physical state of food substrate can be maintained at a critical point for the successful removal of water. This is called _____.
   a. Freeze dehydration
   b. Freeze rehydration
   c. Freezing
   d. None of the mentioned

Section – B

04X04 = 16 Marks

1. Write down the different types of cold storages.
2. Write down the importance of food preservation.
3. Write a short note on raking system.
4. Explain the food preservation methods.

Section – C

04X06 = 24 Marks

1. Write down the advantages of forced draft cooling towers.
2. Explain Drive-in drive-through pallet racking
3. How multistage compressors are useful than single stage compressors?
4. What are the expansion devices? Explain the different types of it.

Registration No.: .....

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Refrigeration & Air Conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, V Semester,

End-Sem. Examination

Course Code: HVA1502 Time: **2 Hours**

Course Name: Cold Chain & Cold Storage Max. Marks: 50

ANSWER KEY-B

Section – A

10X01 = 10 Marks

1. Keeping in mind that texture changes take place after harvest, pulpy fruits become extremely hard after harvest.

b. False

2 After harvest, _____ of fruits and vegetables undergoes change.

a. Texture, nutrients, minerals

3 Which of the following is true about fruits and vegetable processing?

d. All of the mentioned

4 Which of the following is not related to Post Harvest losses?

c. Farmers don't earn much after adding value to products

5. Which of the following are Milk Processing Operations?

d. All of the mentioned

6. Which of the following nutrients are lost in all steps of food engineering (including packaging and freezing)?

b. Vitamins

7. At 100% relative humidity, the wet bulb temperature is-

c. equal to the dew point temperature

8. The horizontal line in psychrometric chart joining the change of state of air represents

b. sensible cooling or heating

9. Pork has a higher shelf life than beef.

b. False

10. It is possible to maintain conditions of temperature and pressure whereby the physical state of food substrate can be maintained at a critical point for the successful removal of water. This is called _____

a. Freeze dehydration

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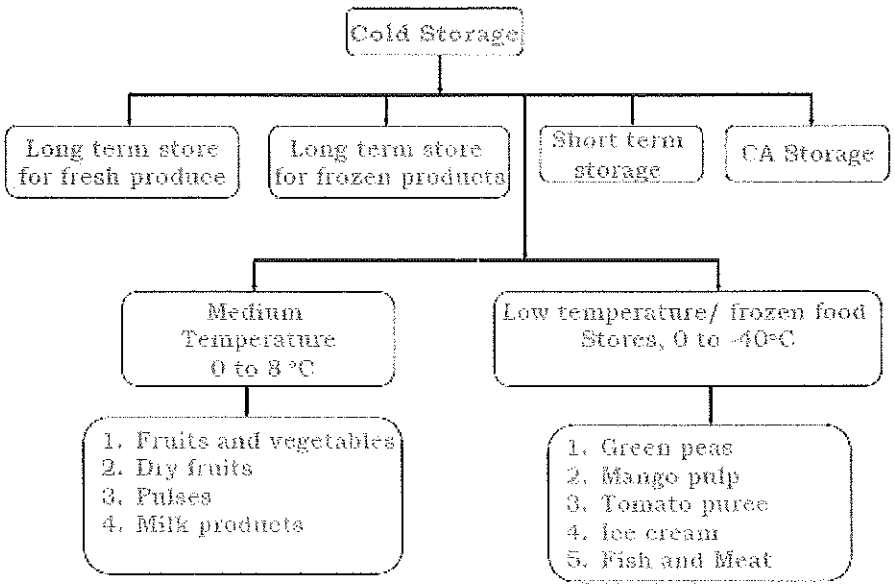
Section – B

04X04 = 16 Marks

1. Write down the different types of cold storages.



2. Write down the importance of food preservation.

   Answer: The main reasons for food preservation are to overcome inappropriate planning in agriculture, produce value-added products, and provide variation in diet. The agricultural industry produces raw food materials in different sectors. Inadequate management or improper planning in agricultural production can be overcome by avoiding inappropriate areas, times, and amounts of raw food materials as well as by increasing storage life using simple methods of preservation. Value-added food products can give better-quality foods in terms of improved nutritional, functional, convenience, and sensory properties. Consumer demand for healthier and more convenient foods also affects the way food is preserved. Eating should be pleasurable to the consumer, and not boring. particularly in underdeveloped countries to reduce reliance on a specific type of grain (i.e., rice or wheat).

3. Write a short note on raking system.

   Answer: A racking system is one of several constituent parts of a warehouse system and can only be fully defined when all the other parameters of a warehousing operation are considered. It is totally dependent on what the user requires from the operational warehouse unit. At one end of the scale is a system that is 'all things to all men' and at the other end is a system dedicated to one customer with a fixed long-term requirement.

4. Explain the food preservation methods.

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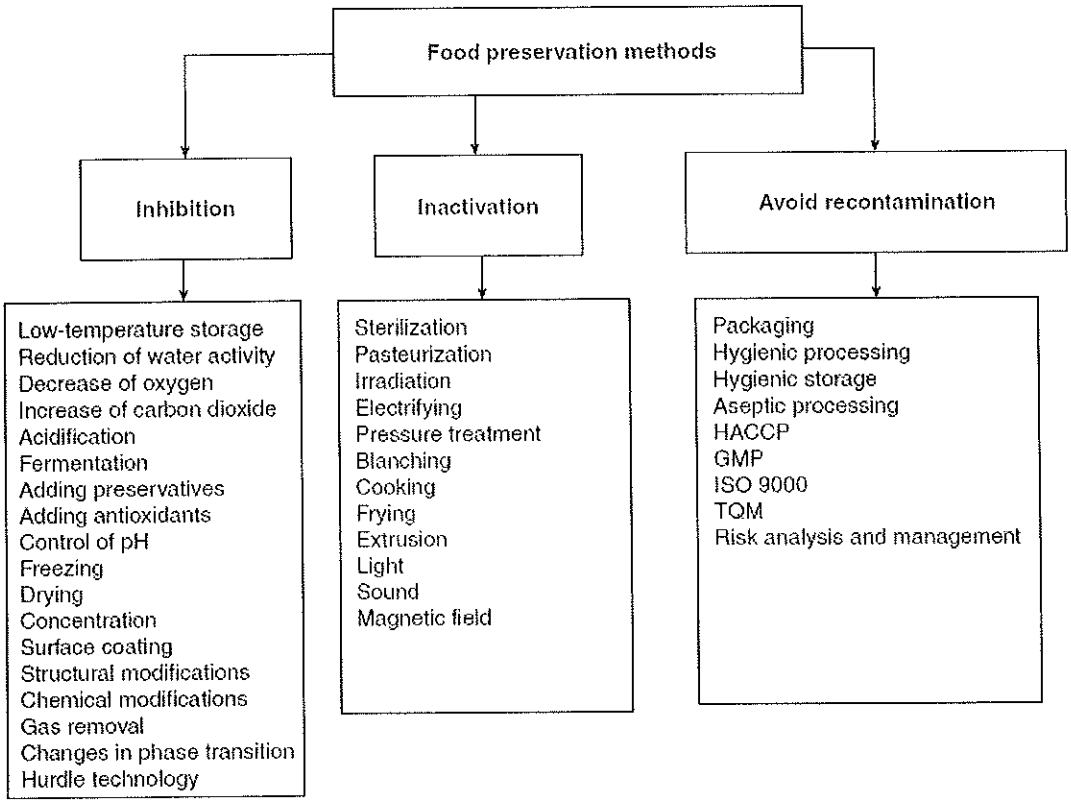

Section – C

04X06 = 24 Marks

1. Write down the advantages of forced draft cooling towers.

Answer:

1. Forced draft (FD) towers are more efficient than ID draft because some of the air velocity is converted into static pressure in the tower and recovered in the form of useful work.
2. The vibration and noise are minimal because mechanical equipment is set on solid foundations.
3. Because it handles dry air, problems of blade erosion are avoided.
4. It is safer because it is located on the ground level.

2. Explain Drive-in drive-through pallet racking

Answer: This system uses a form of racking which allows each pallet to be supported individually but gives a similar cube utilization to block stacking. Drive-in dictates that the loads stored will be last in, first out (LIFO). Drive-through enables a first in, first out (FIFO) operation to take place. The system generally uses racking uprights fitted with pallet support rails cantilevered from the side of the uprights (Figure 9.11). These rails run from front to rear and form the required storage levels. The uprights are fixed to the floor and tied above the top pallet level. The structure is also braced above the top pallet level. Lanes are therefore formed down which a truck can be driven to access each level of pallets. All levels in each lane have to be filled or emptied at the same time, which, in turn, means that each lane must contain the

same product. The difference between drive-in and drive-through is that with drive-in each block can only be accessed from one side, whereas drive-through can be accessed from both sides with no structural impediments in any of the lanes. As drive-through usually requires a higher level of strength to be derived from the steelwork above the top pallet, it is therefore less cost effective than drive-in. A simple solution is to place two drive-in installations back to back when access is required from both sides and FIFO is not important.

3. How multistage compressors are useful than single stage compressors?

When the compression ratio required is considerably high, as in the case of low temperature refrigeration systems, the single-stage compression is highly uneconomical due to the following reasons.

1. Very low volumetric efficiency
2. High frictional losses
3. Leakage problems
4. High running cost

In multistage compression, the compression of refrigerant from initial pressure to final pressure is carried out in more than one cylinder. A multistage compression with intermediate cooling is generally adopted for economical working.

4. What are the expansion devices? Explain the different types of it.

An expansion device in a refrigeration system normally serves two purposes. One is the thermodynamic function of expanding the liquid refrigerant from the condenser pressure to the evaporator pressure. The other is the control function, which may involve supply of the liquid to the evaporator at the rate of which it is evaporated.

The different devices that are used to perform these functions include the following:

1. Capillary tube
2. Pressure control or automatic expansion valve
3. Thermostatic expansion valve
4. High-side float valve
5. Low-side float valve

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A

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Course Code: HVA1503 Set-A **Time: 2 Hour**

Course Name: Chilled water supply system design **Max. Marks: 50**

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

Q. 1: The commonly used refrigerant in ice plant is

A. NH_3
B. CO_2
C. R-12
D. none of these

Q. 2: Efficiency of Electric-drive air-cooled scroll chiller is

A. 1.6
B. 1.9
C. 3.25
D. 5.8

Q. 3: Chillers operate efficiently in range of

A. 30% to 60% load
B. 40% to 80% load
C. 20% to 50% load
D. 10% to 70% load

Q. 4: Pipe schedule 40 is used for

A. Less than 18-inch pipe size
B. Less than 20-inch pipe size
C. Less than 10-inch pipe size
D. Less than 14-inch pipe size

Q. 5: The wall thickness of copper tubing is indicated by

A. Types K, L, and M
B. Types A, B, and C
C. Types J, K, and L
D. Types D, E, and F

Q. 6: The purge unit in a low-pressure chiller removes

A. overcharge of refrigerant.
B. excess oil.
C. condensable refrigerant.
D. non-condensable

Q. 7: The compressor used in low-pressure chillers is the

A. Centrifugal
B. Screw
C. Rotary
D. Reciprocating

Q. 8: When a chiller is used, the secondary refrigerant that circulates in the building is

A. Air
B. water
C. barine
D. glycol

Q. 9: A vapour absorption refrigeration system

A. gives noisy operation
B. gives quiet operation
C. requires more power consumption
D. have more wear and tear

Q. 10: In aqua-ammonia and Li-Br water absorption refrigeration system, the refrigerants are respectively

A. water and water
B. water and Li-Br
C. ammonia and Li-Br
D. ammonia and water

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: Classified the refrigerants with examples.

Q. 2: Explain line mounted and base mounted pumps.

Q. 3: Explain engine drive chillers with neat sketch.

Q. 4: Explain one-pump parallel chiller configuration.

Section – C

04*06 = 24 Marks

Note: Each question carries 06 mark.

Q. 1: Compare the vapour absorption refrigeration system over vapour compression refrigeration system.

Q. 2: Explain vapour absorption refrigeration cycle with neat sketch.

Q. 3: Explain chiller heat recovery with neat sketch.

Q. 4: Define commissioning. What are necessary steps required at the time of maintenance of chiller?

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Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Answer key

Course Code: HVA1503 **Time: 2 Hour**

Course Name: Chilled water supply system design **Max. Marks: 50**

Section – A

10*01 = 10 Marks

10 objective type questions, each question carries 01 mark.

Q. 1: B

Q. 2: C

Q. 3: B

Q. 4: C

Q. 5: A

Q. 6: D

Q. 7: A

Q. 8: B

Q. 9: B

Q. 10: D

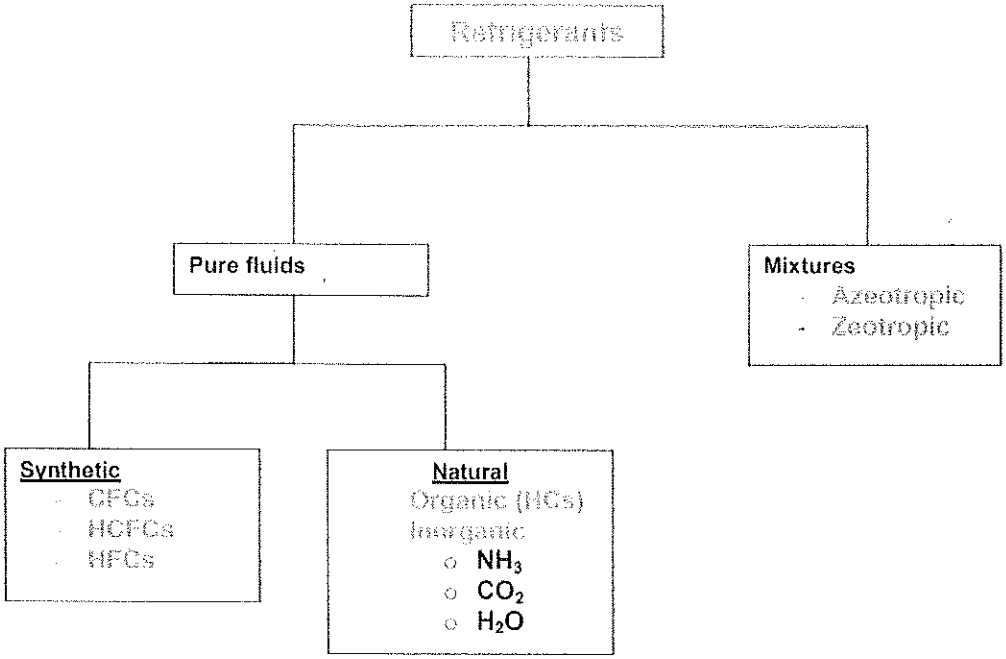
Section – B

4X4 = 16 Marks

4 short answer type questions, each question carries 04 marks.

Q. 1: Classified the refrigerants with examples.

Ans.



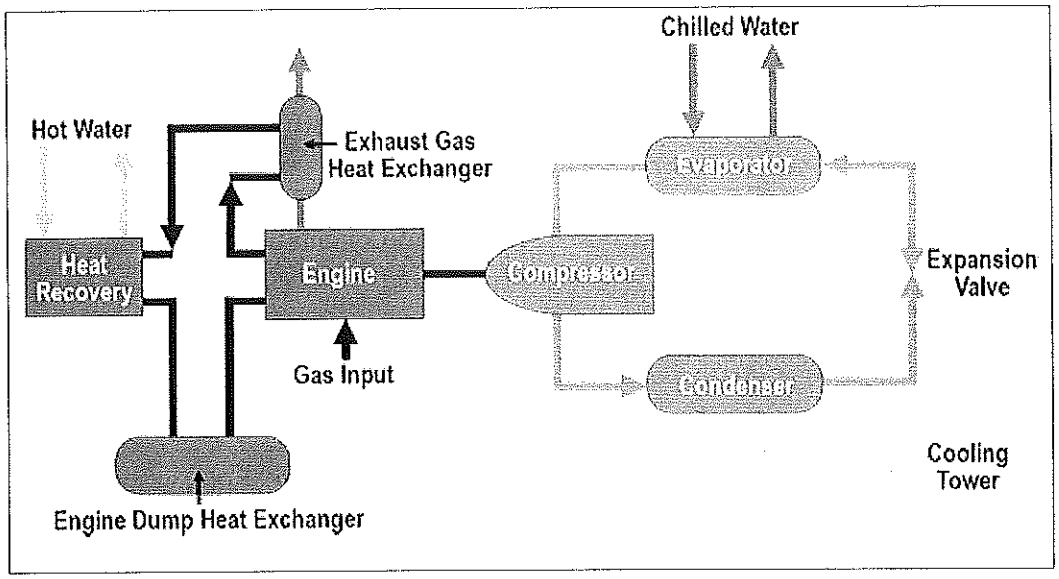
Q. 2: Explain line mounted and base mounted pumps.

Ans. Line-mounted pumps: These pumps can be installed directly in the piping since the suction and discharge connections are arranged 180° apart. The motor and pump shafts, typically, are mounted vertically. The pump may be supported by the piping and/or by additional hangers or a foot stand.

Base-mounted pumps: Base-mounted pumps have the motor and pump shafts mounted horizontally, with both the pump and the motor bolted to a common frame or base. These pumps are available in two configurations.

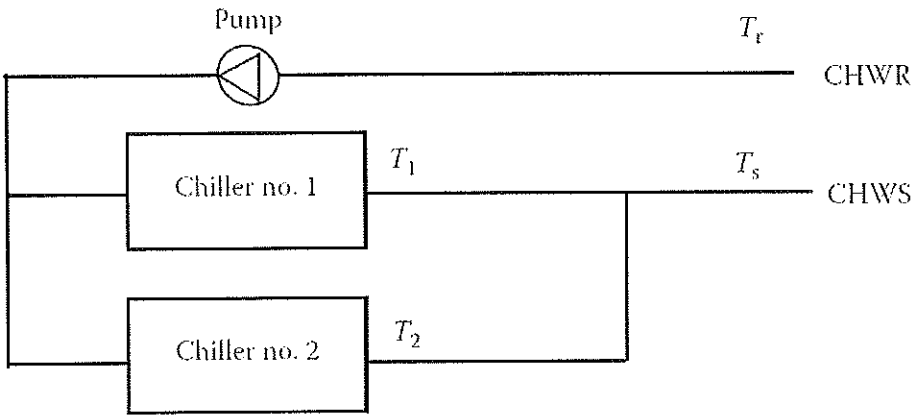
Q. 3: Explain engine drive chillers with neat sketch.

Ans. In an open-drive configuration, natural gas- and propane-fueled spark ignition engines have been applied to rotary compressor systems. The full-load cooling COPs for engine-drive chillers are ~1.3–1.9 for helical screw compressors and 1.9 for centrifugal compressors. These low COPs can be improved if the engine water jacket heat and exhaust heat can be recovered to heat service hot water or for other uses. Engine-drive chillers have been around for many years, but their application, most typically utilizing natural gas for fuel, has been limited by a number of factors.



Q. 4: Explain one-pump parallel chiller configuration.

Ans. With this configuration, there is an inherent problem. If both machines were operated for the full-load range (15–100% of peak capacity), by the time the total system load drops to 30% of full load, each individual chiller would be operating very inefficiently. Thus, most designers utilize controls to shut off one chiller when the total system load, as evidenced by the return chilled water temperature, falls below 40% of full load. However, with this piping arrangement, if one chiller is not in operation, chilled water from the operating chiller will mix (blend) with the return water passing through the nonoperating chiller, effectively raising the system's chilled water supply temperature.



Section – C

04X06 = 24 Marks

04 essay type questions, each question carries 06 marks.

Q. 1: Compare the vapour absorption refrigeration system over vapour compression refrigeration system.

Ans.

Advantages of VARS over VCRC

1. In the VARS, the only moving part of the entire system is a pump which has a small motor. Thus, the operation of this system is essentially quiet and is subjected to little wear. The vapour compression system of the same capacity has more wear, tear and noise due to moving parts of the compressor.
2. VARS system uses heat energy to change the condition of refrigerant from the evaporator. The VCRC system uses mechanical energy to change the condition of refrigerant from the refrigerant.
3. The VARS system are usually designed to use steam, either at high pressure or low pressure. The exhaust heat from furnaces and solar energy may also be used. Thus, this system can be used where the electric power is difficult to obtain or is very expensive.
4. The space requirements and automatic control requirements favor the absorption system more and more as the desired evaporator pressure drops.
5. The VARS system can be built in capacities well above 1000 tons of refrigeration each, which is the largest size for single compressor units.
6. The load variations do not affect the performance of VARS system. The performance of a vapour compression system at partial loads is poor.
7. In the VARS system, the liquid refrigerant leaving the evaporator has no bad effect on the system except that of reducing the refrigerating effect. In the VCRC system, it is essential to superheat the vapour refrigerant leaving the evaporator so that no liquid may enter the compressor.

Disadvantage:

1. Less COP
2. More space required
3. More amount of refrigerant is circulated, which increase the running cost.

Q. 2: Explain vapour absorption refrigeration cycle with neat sketch.

Ans. In this system, the vapour refrigerant from the evaporator is drawn into an absorber where it is absorber by weak solution of the refrigerant forming a strong solution. This strong solution is pumped to the generator where it is heated by some external source (waste heat or solar energy). During the heating process, the vapour refrigerant is driven off by the solution and enters into the condenser where it is liquified. The liquid refrigerant then flows into the evaporator and thus the cycle is completed. The vapour absorption system uses heat energy, instead of mechanical energy as in VCRC. In VARS, the compressor is replaced by an

absorber, a pump, a generator and a pressure reducing valve. These components in VARS perform the same function as that of a compressor in VCRC system.

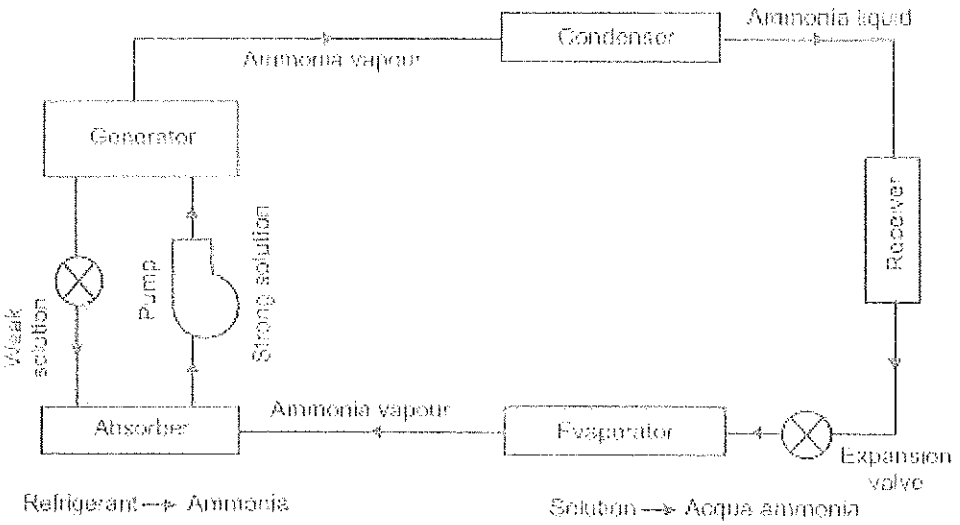


Fig. Vapour absorption refrigeration system

Q. 3: Explain chiller heat recovery with neat sketch.

Ans. The heat collected by a water-cooled chiller during cooling must be rejected through the condenser to a cooling tower (or evaporative cooler). However, if there is a simultaneous need for heating and cooling by the building, then this heat can be *recovered* and utilized rather than simply rejected to the outdoors.

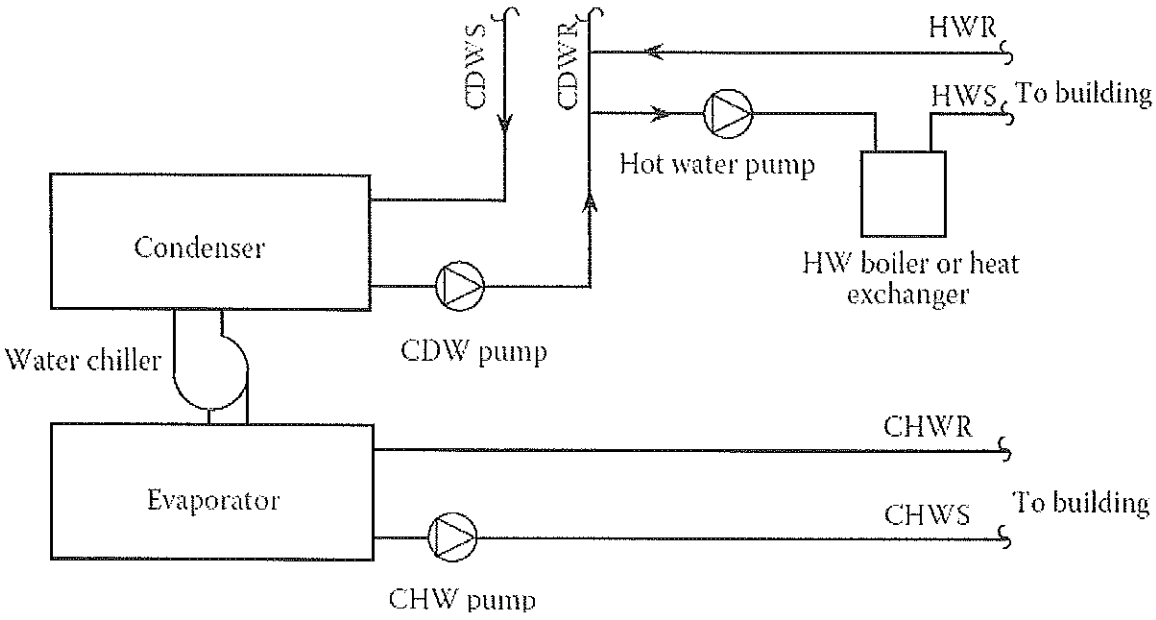
However, if there is a simultaneous need for heating and cooling by the building, then this heat can be recovered and utilized rather than simply rejected to the outdoors.

However, if there is a need for low-level (85–95°F) heat during the cooling season, then recovery and use of condenser heat should be implemented as an energy-saving design element.

Typical applications include the following:

1. Domestic hot-water preheating can be applied as shown in Figure. Municipal supply water temperatures can range from 65°F to 85°F during the summer. For buildings with high domestic hot-water requirements (hospitals, research laboratories, dormitories, etc.), preheating the incoming water via a water-to-water heat exchanger will reduce hot-water heating costs.
2. Summer reheat loads can be met with condenser heat and the use of a water-to-water heat exchanger as shown in Figure. Since no space heating is required during the summer, the maximum reheat requirement is to bring the air to room temperature, typically 75°F. This temperature is within the range of the condenser water temperature available.

3. 3. Process heating loads can be met with condenser heat if their thermal level is below about 80°F.



Q. 4: Define commissioning. What are necessary steps required at the time of maintenance of chiller?

Ans. Commissioning: To ensure that this type of operation is attainable, the chilled water system must be properly installed and placed into service and its operation verified by test, a process called commissioning.

Steps required at the time of maintenance of chiller

1. Clean evaporator every 2–4 years (annually for chillers serving air washers or other "open" cooling loads).
2. Quarterly, calibrate pressure, temperature, and flow controls.
3. Annually, inspect starter wiring connections, contacts, and action. Tighten and adjust as required. Perform thermographic survey every 5 years.
4. Annually, test the operation of safety interlocks devices, such as flow switches, pump starter auxiliary contracts, phase-loss protection, and so on. Repair or replace as required.
5. Annually, perform dielectric motor testing to identify failures in motor winding insulation. For large chillers (100 tons or larger), additional annual motor tests are required to test for imbalance of electrical resistance among windings, imbalance of total inductance with phase inductances, power factor, capacitance imbalance, and running amperage versus nameplate amperage.

6. Annually, check the tightness of the hot gas valve (as applicable). If the valve does not provide tight shutoff, replace it.
7. Annually, change the lubricant (oil) filter and the drier.
8. Laboratory analysis of the lubricant should be performed annually during the first 10 years of chiller life and every 6 months thereafter. [This oil analysis will define the moisture content (not to exceed 50 ppm), oil acidity (maximum 1 ppm) that may indicate oil oxidation and/or refrigerant degradation due to high temperatures, and metals or metal oxides that indicate chiller component wear and/or moisture in the oil.]
9. Valve and bearing inspection in accordance with manufacturer's recommendation.
10. Relief valves (both refrigerant and water) should be checked annually. Disconnect the vent piping at the valve outlet and visually inspect the valve body and mechanism for corrosion, dirt, or leakage. If there are problems, replace the valve; do not attempt to clean or repair it.

B

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination Set-B B

Course Code: HVA 1503 **Time: 2 Hour**

Course Name: Chilled water supply system design **Max. Marks: 50**

Section – A

10*01 = 10 Marks

Note: Each question carries 01 mark.

Q. 1: The purge unit in a low-pressure chiller removes

A. overcharge of refrigerant. B. excess oil.
C. condensable refrigerant. D. non-condensable

Q. 2: The compressor used in low-pressure chillers is the

A. Centrifugal B. Screw
C. Rotary D. Reciprocating

Q. 3: When a chiller is used, the secondary refrigerant that circulates in the building is

A. Air B. water
C. barine D. glycol

Q. 4: A vapour absorption refrigeration system

A. gives noisy operation B. gives quiet operation
C. requires more power consumption D. have more wear and tear

Q. 5: In aqua-ammonia and Li-Br water absorption refrigeration system, the refrigerants are respectively

A. water and water B. water and Li-Br
C. ammonia and Li-Br D. ammonia and water

Q. 6: The commonly used refrigerant in ice plant is

A. NH_3 B. CO_2
C. R-12 D. none of these

Q. 7: Efficiency of Electric-drive air-cooled scroll chiller is

A. 1.6 B. 1.9
C. 3.25 D. 5.8

Q. 8: Chillers operate efficiently in range of

A. 30% to 60% load
B. 40% to 80% load
C. 20% to 50% load
D. 10% to 70% load

Q. 9: Pipe schedule 40 is used for

A. Less than 18-inch pipe size
B. Less than 20-inch pipe size
C. Less than 10-inch pipe size
D. Less than 14-inch pipe size

Q. 10: The wall thickness of copper tubing is indicated by

A. Types K, L, and M
B. Types A, B, and C
C. Types J, K, and L
D. Types D, E, and F

Section – B

04*04 = 16 Marks

Note: Each question carries 04 mark.

Q. 1: What is the purpose of a chiller economizer?

Q. 2: What are the differences between symmetrical and asymmetrical chiller?

Q. 3: Explain thermal energy storage system with classification.

Q. 4: Define the terms with respect to chiller:- off peak period, on peak period, charging and discharging.

Section – C

04*06 = 24 Marks

Note: Each question carries 06 mark.

Q. 1: Explain the water-cooled HVAC system with neat sketch.

Q. 2: Explain primary and secondary parallel configuration with neat sketch.

Q. 3: Write down the recommendations to prevent the transfer of sound and vibration from chillers and pumps.

Q. 4: Define commissioning. What are necessary steps required at the time of maintenance of chiller?

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration and Air-conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, 5th Semester,

End-Sem. Examination

Answer key

Course Code: HVA 1503 **Time: 2 Hour**

Course Name: Chilled water supply system design **Max. Marks: 50**

Section – A

10*01 = 10 Marks

10 objective type questions, each question carries 01 mark.

Q. 1: D
Q. 2: A
Q. 3: B
Q. 4: B
Q. 5: D
Q. 6: A
Q. 7: C
Q. 8: B
Q. 9: C
Q. 10: A

Section – B

4X4 = 16 Marks

4 short answer type questions, each question carries 04 marks.

Q. 1: What is the purpose of a chiller economizer?

Ans. Economizer in chiller system is the mechanical device or unit allowing to reduce energy consumption and improve the efficiency of chiller system. This is done by cooling the hotter side either outside the building or inside. It is modification of chiller system or chiller itself whose initial cost is covered by significant economic benefits from the further operation.

Q. 2: What is the difference between symmetrical and asymmetrical chiller?

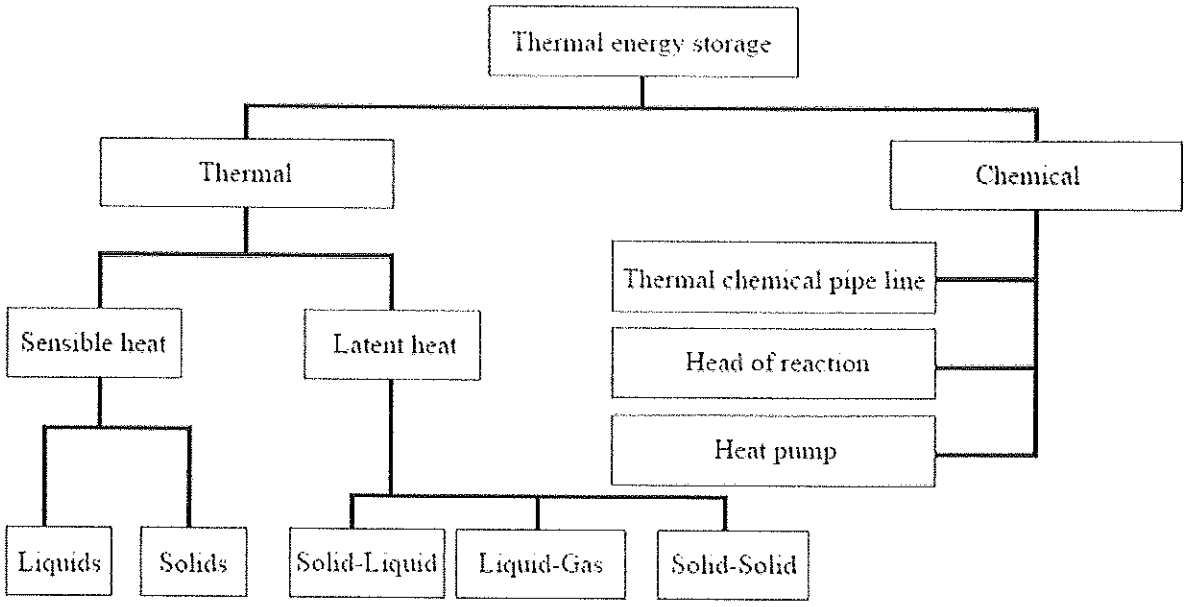
Ans. Symmetrical chiller: With this approach, all of the chillers are sized for equal capacity. The number of chillers and, thus, the size of the chiller "module" are based on the minimum anticipated load.

Asymmetrical chiller: There is no engineering rule that says that all chillers in a multichiller system have to be of the same size. While there may be some maintenance advantages (common parts, etc.), different-sized chillers can be operated together.

Q. 3: Explain thermal energy storage system with classification.

Ans. Thermal energy storage (TES) allows the storage of heat and cold, which is used later. TES is also known as heat or cold storage. TES can aid in the efficient use and provision of thermal energy whenever there is a mismatch between energy generation and use. This

mismatch can be in terms of time, temperature, power, or site. Different methods for TES are defined and discussed – sensible (air, water, and underground thermal energy storage) and latent (with phase change materials). Cool thermal energy storage (CTES) has recently attracted increasing interest in industrial refrigeration applications, such as process cooling, food preservation, and building air-conditioning systems.



Q. 4: Define the terms with respect to chiller:- off peak period, on peak period, charging and discharging.

Ans. Off peak period represent when the system is not in use while on peak period represent when system is working. Charging represents the off-peak period production of cooling energy by the chiller that is stored, while discharging is the use of that stored energy during the on-peak period.

Section – C

04X06 = 24 Marks

04 essay type questions, each question carries 06 marks.

Q. 1: Explain the water-cooled HVAC system with neat sketch.

Ans.

- Loop 1: Air system: Cold air is distributed by one or more air-handling units (AHUs) to the spaces within the building. The distributed air is returned to the air handling unit, mixed with the required quantity of outdoor air for ventilation.
- Loop 2: Chilled water system: The warmer-returned chilled water enters the water chiller where it is cooled to the desired chilled water supply temperature by transferring the heat extracted from the building spaces to a primary refrigerant.

- Loop 3: Condenser water system: The heat of compression must then be added to the heat load on the chilled water loop to establish the amount of heat that must be rejected by the condenser to a heat sink, typically the outdoor air.

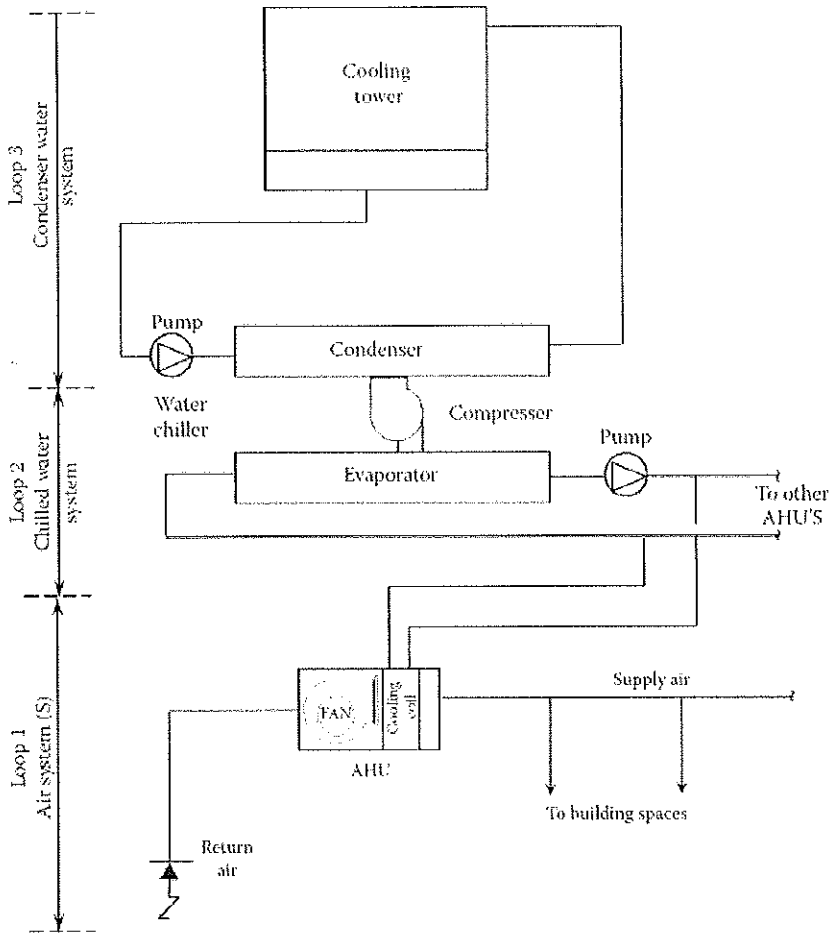
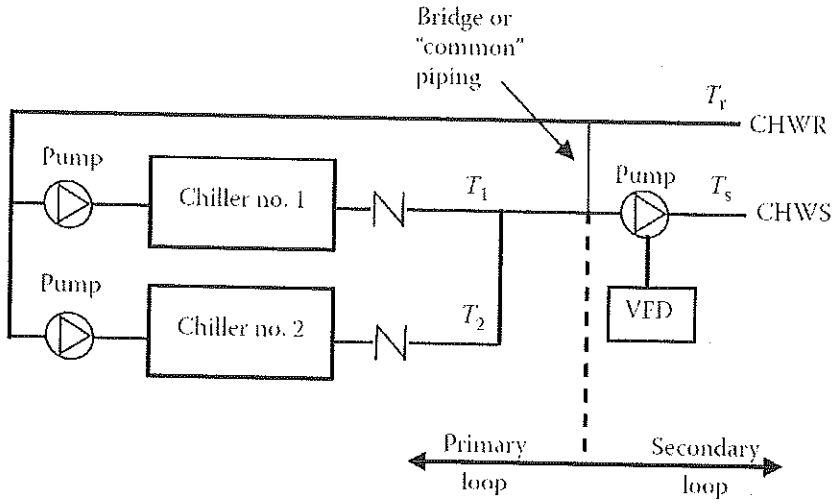


Fig. Water-cooled HVAC system

Q. 2: Explain primary and secondary parallel configuration with neat sketch.

Ans. In the primary–secondary variable flow piping arrangement, here, the production loop (primary loop) through the two chillers is hydraulically isolated from the distribution loop (secondary loop) by a piping bridge. The bridge is a short section of piping shared by both loops and designed to have little or no pressure drop. Thus, the flow in one loop is not affected by flow in the other. On the primary or production loop side, the system acts as multiple-pump parallel chiller installation, as described earlier. Flow in this loop varies in "steps" as the chillers are staged on or off and their respective pumps are started and stopped. However, in the secondary or distribution loop, the cooling coils utilize two-way control

valves and the distribution pump(s) utilize a variable frequency drive(s) (VFD) so that the chilled water flow rate is modulated from 0% to 100% of peak design flow as a function of the imposed cooling load. Thus, this loop has fully variable flow, but maintains a constant temperature range.



Q. 3: Write down the recommendations to prevent the transfer of sound and vibration from chillers and pumps

Ans.

- *If feasible, locate chillers in a mechanical equipment building separate from occupied buildings*. If the chiller room is integrated into an occupied building, the walls and ceiling must be designed to prevent noise transfer. Masonry construction and, perhaps, interior acoustical treatments will be required.
- All piping and conduit penetrations must be sealed with flexible materials to stop noise and prevent the transfer of vibration to the building walls and floors.
- Mount all equipment on vibration isolators. Pumps can be isolated with inertia bases and spring isolators. If the chiller is installed in a ground floor or basement location, it can be isolated with cork-and-rubber pads designed to support the weight of the chiller without fully compressing. If located on an upper floor of a building, the chiller should be installed with spring vibration isolators as shown in Figure.
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Q. 4: Define commissioning. What are necessary steps required at the time of maintenance of chiller?

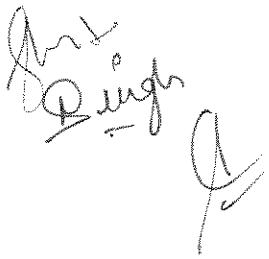
Ans. Commissioning: To ensure that this type of operation is attainable, the chilled water system must be properly installed and placed into service and its operation verified by test, a process called commissioning.

Steps required at the time of maintenance of chiller

1. Clean evaporator every 2–4 years (annually for chillers serving air washers or other "open" cooling loads).
2. Quarterly, calibrate pressure, temperature, and flow controls.
3. Annually, inspect starter wiring connections, contacts, and action. Tighten and adjust as required. Perform thermographic survey every 5 years.
4. Annually, test the operation of safety interlocks devices, such as flow switches, pump starter auxiliary contracts, phase-loss protection, and so on. Repair or replace as required.
5. Annually, perform dielectric motor testing to identify failures in motor winding insulation. For large chillers (100 tons or larger), additional annual motor tests are required to test for imbalance of electrical resistance among windings, imbalance of total inductance with phase inductances, power factor, capacitance imbalance, and running amperage versus nameplate amperage.
6. Annually, check the tightness of the hot gas valve (as applicable). If the valve does not provide tight shutoff, replace it.
7. Annually, change the lubricant (oil) filter and the drier.
8. Laboratory analysis of the lubricant should be performed annually during the first 10 years of chiller life and every 6 months thereafter. [This oil analysis will define the moisture content (not to exceed 50 ppm), oil acidity (maximum 1 ppm) that may indicate oil oxidation and/or refrigerant degradation due to high temperatures, and

metals or metal oxides that indicate chiller component wear and/or moisture in the oil.]

9. Valve and bearing inspection in accordance with manufacturer's recommendation.
10. Relief valves (both refrigerant and water) should be checked annually. Disconnect the vent piping at the valve outlet and visually inspect the valve body and mechanism for corrosion, dirt, or leakage. If there are problems, replace the valve; do not attempt to clean or repair it.



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration & Air conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, V-Semester,

End Sem. Examination

Set-A

Course Code: HVA1504 **Time: 2 Hour**

Course Name: AC system & Testing **Max. Marks: 50**

Instruction:

1.Read the question carefully.

2.Take given dimensions in Inches or convert them.

Section – A

05X01 = 05 Marks

Q1.) What is Nacph_____

a) Number of air change per hour
b) Number of air condensed per hour
c) Number of person cfm per hour
d) Number of air cumulated per hour

Q2) The condition of refrigerant after passing through the condenser in a vapour compression system is.

a) Saturated liquid
b) Wet vapour
c) Dry saturated vapour
d) Superheated vapour

Q3) NBC Stands for

a) National boiler codes
b) National BIM Codes
c) National bureau of standard
d) National building codes

Q4) BIS-277 is for _____

a) Sheet Metal Specification (GI).
b) BIS-655 Sheet Metal Fabrication and Erection Installation (GI).
c) Sheet Metal Work Safety Standards.
d) DUCT WORK

Q5) LEED Is to regulate

a) Environment
b) Duct design
c) Duct working codes.
d) Manufacturing and installation of air units

Q6. GPM determines_____ ?

a) Flow
b) Velocity
c) Pressure
d) Duct discharge

Q7 Fire dampers are certified by.

a) Under writer's laboratory
b) Ashrae
c) Ishrae
d) Duct work

Q8) Attic Space is the space _____?

a) Between BOFC & SSLB
b) SLAB & FFL
c) BOFC & FFL
d) SSLB & WINDOW

Q9) Compressor with Screws are called _____ ?

a) Screw Compressor
b) Hermetic sealed
c) Lobe
d) Scroll

Q10. Pipe work has _____& _____ ?

a) Flow & Velocity
b) Flow
c) Pressure & flow
d) Fluidity & pressure

Section – B

04X04 = 16 Marks

Q11. How ducts are designed, Name the methods along with variable to control?

Q12. Name the types of fitting used in Central HVAC systems?

Q13. Using the continuity equation calculate the sizes of duct?
whose area is.
1)100 sq ft
2)156 sq inches
3) 64 sq ft
4) 225 sq inches

Q14. What are the Types of compressor used in central plant (Chiller) with Neat and diagram?

Section – C 06X04 =24Marks

Q15. For the given dimension of duct find (Using sheet of 8*3=3456sq inch)

a) Number of sheets required

b) Weight of duct take density =7.85 kg/m^2

1. 20" × 20" ×10"

Q16. Classify the duct based on

1)Shapes

2) Velocity with range

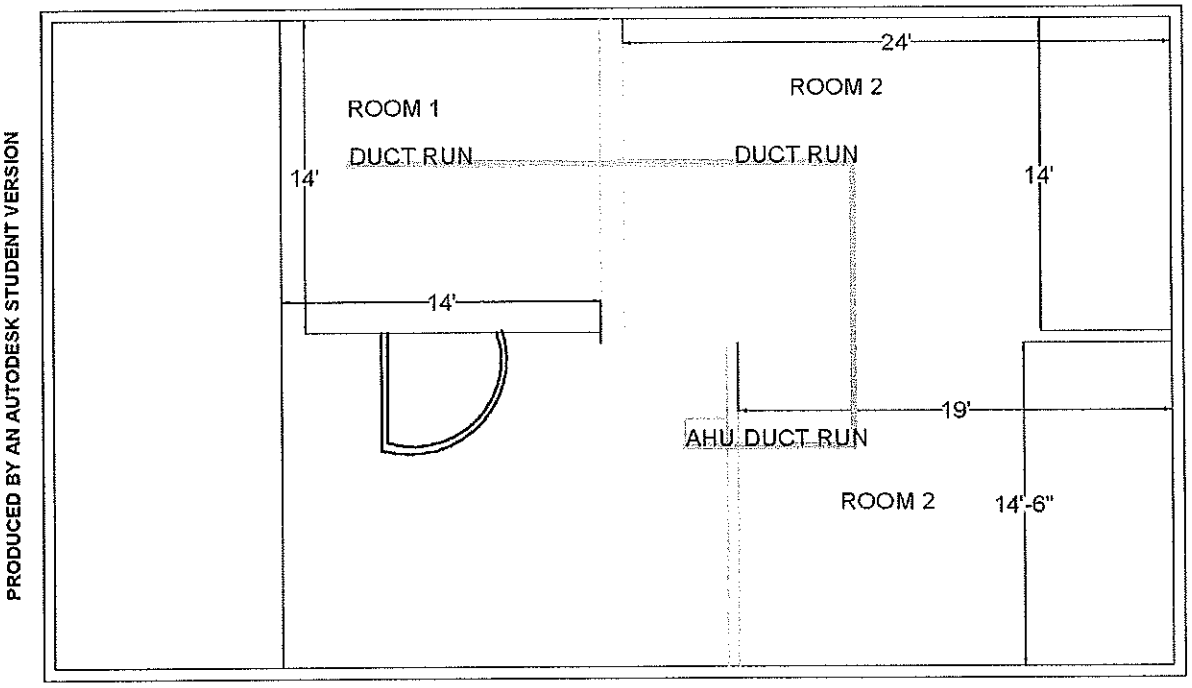
Q3) Calculate the required CFM and design the Duct for given building? Height to take 10.'

1) CFM of air required

2) Line diagram for duct design using EFM

3) Line diagram for duct design using EFM.

DUCT	CFM	VELOCITY	PRESSURE AT	Duct size D equivalent	Pipe sizes	GPM
Room 1		400	0.05"			800
Room 2		450	0.05"			500
Room 3		420	0.05"			300



1.CALCULATE CFM FOR ROOM 1,2 AND 3
2.WRITE DUCT DIMENSIONS
3.Make a table and fill in values for blanks

Q17. What are the types of Air Ventilation Explain with the help of A neat sketch?

Q18. Draw the flow chart for building survey/Project?

Source : ASHRAE Handbook 2013

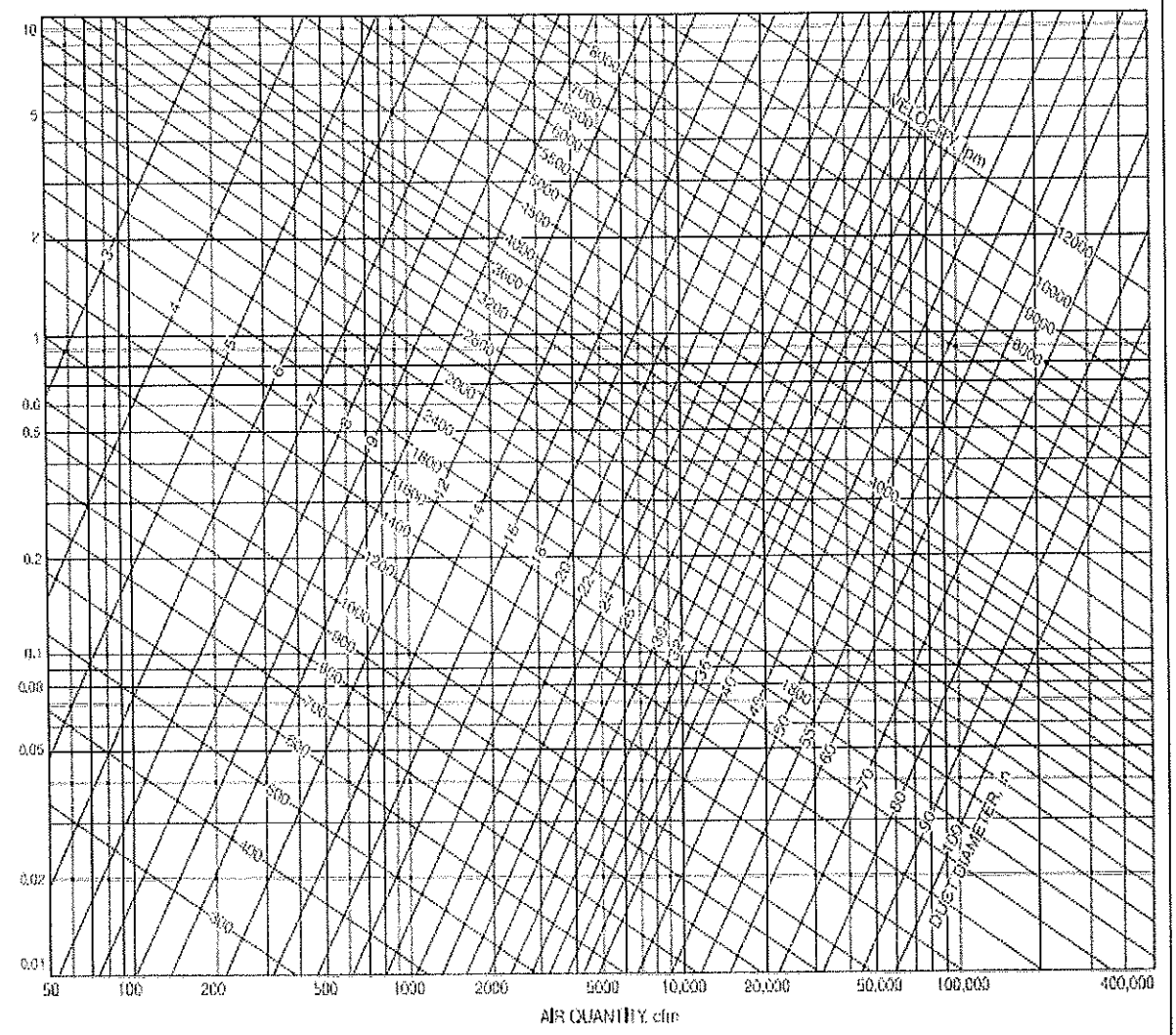
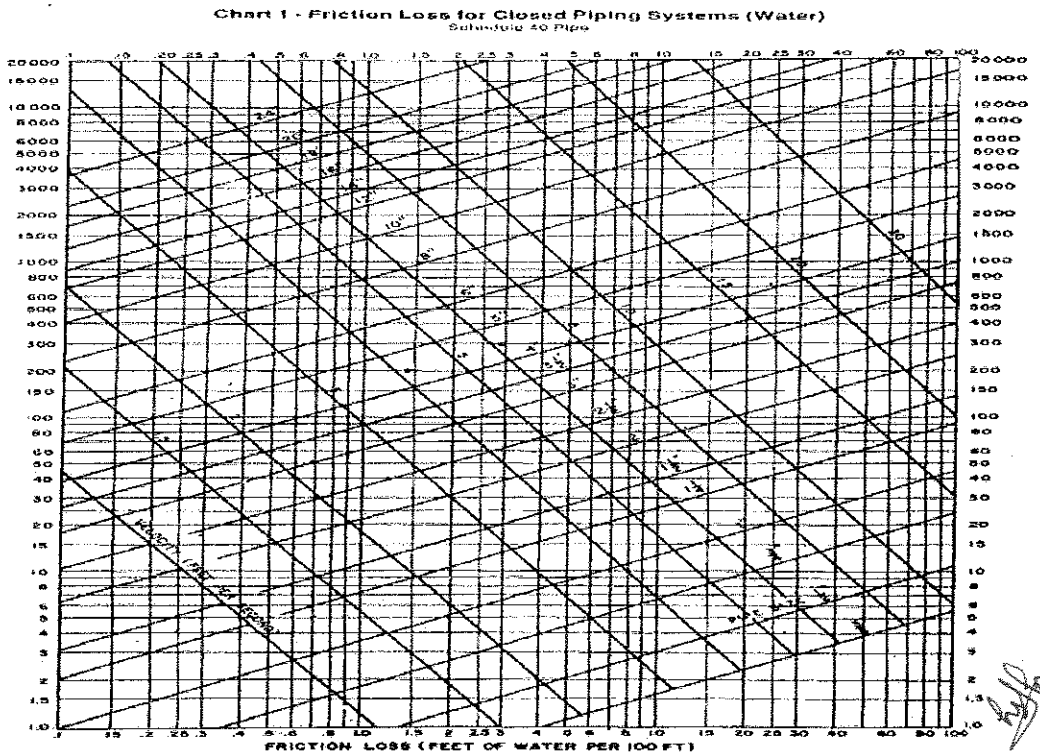


Figure 2.7 : Rigid Duct Design - Friction Chart
Friction chart for Round Duct, Air Density = 0.075 lb/ft3 and ε = 0 0.003 ft.



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

A

Registration No.: .....

School of Refrigeration & Air conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, V-Semester,

End Sem. Examination

Course Code: HVA1504 **Time: 2 Hour**

Course Name: AC system & Testing **Max. Marks: 50**

Answer key

Instruction:

1.Read the question carefully.

2.Take given dimensions in Inches or convert them.

Section – A

05X01 = 05 Marks

Q1.) What is Nacph_____

a) Number of air change per hour

Q2) The condition of refrigerant after passing through the condenser in a vapour compression system is.

a) Saturated liquid

Q3) NBC Stands for

d) National building codes

Q4) BIS-277 is for _____

a) Sheet Metal Specification (GI).

Q5) LEED Is to regulate

a) Environment

Q6. GPM determines_____?

a) Flow

Q7 Fire dampers are certified by.

a) Under writer's laboratory

Q8) Attic Space is the space _____?

a) Between BOFC & SSLB

Q10. Pipe work has _____& _____?

a) Flow & Velocity

Section – B

04X04 = 16 Marks

Q11. How ducts are designed, Name the methods along with variable to control?
A11. Duct shapes

Round,

square,

flat

oval shape.

According to Duct velocity

1. Low – up to 1500 FPM
2. Medium -1500-2500 FPM
3. High 2500-4500 FPM

Velocity reduction Method – Velocity
Equal friction method- Friction constant-
Static pressure regain- Static pressure of air to be constant

Q12. Name the types of fitting used in Central HVAC systems?
A12. Reducers-Reducers are produced in diameters range 80 to 1600 mm of galvanized, aluminium and acid-resistant steel. They are used to ventilation systems.

They are recommended in the version with EPDM seals to ensure achieving "D" class leak tightness according to Eurocent (SITAC certificate

- Short symmetric reducers which are mainly offered as pressed elements.
- Long segmented reducers, symmetric and asymmetric,

Q13. Using the continuity equation calculate the sizes of duct?
whose area is.
1)100 sq ft
2)156 sq inches
3) 64 sq ft
4) 225 sq inches
A13. 1)100 sq ft = 10*10 ft =120" *120"

2)156sq inches =14" *14"

3) 8X8 sq = 96"X96"

4) 15*15 Sq inches

1) CFM of air required

2) Line diagram for duct design using EFM

DUCT	CFM	VELOCITY	PRESSURE AT	Duct size D equivalent

A	65.33	400	0.05"	6"
A1	112	450	0.05"	6.5"
B	92.46/93	420	0.05"	6"

Q14. What are the Types of compressor used in central plant (Chiller) with Neat and diagram?

A14.

Reciprocating Compressors

Reciprocating compressors use a piston and cylinder to compress incoming refrigerant. As the piston moves downward, refrigerant is drawn into the cylinder. The piston then moves upwards compressing the refrigerant and discharging it downstream to the condenser. Intake and exhaust valves ensure that the refrigerant does not flow backwards.

Centrifugal Compressor Rotary vane compressors typically are quieter than other options. They consist of vanes or blades that are attached to a core rotor. The rotor is positioned off-centre within its cylinder, creating multiple areas of varying sizes.

Scroll compressors work by compressing the refrigerant between two spiral plates, one stationary and one orbiting.

Screw Rotary screw compressors have two interlocking helical rotors mounted inside a casing. As the rotors turn, the gas is forced from the suction end of the casing to the discharge end. The available space between the rotors and the casing becomes increasingly smaller as the gas moves along the length of the screw, increasing the pressure.

Section – C 06X04 =24Marks

Q15. For the given dimension of duct find (Using sheet of 8*3=3456sq inch)

a) Number of sheets required

b) Weight of duct take density =7.85 kg/m^2

1. 20" × 20" ×10"

Q16. Classify the duct based on

A16. Shapes

2) Velocity with range

Q. Calculate the required CFM and design the Duct for given building? Height to take 10.'

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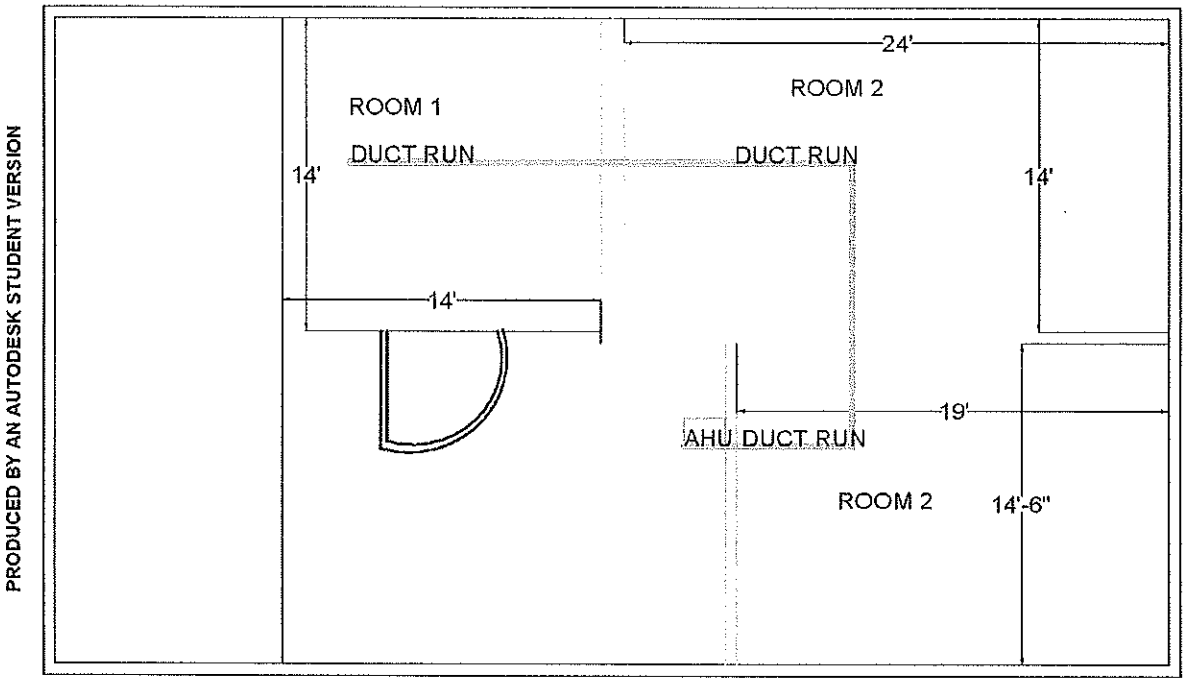
3) Line diagram for duct design using EFM.

DUCT	CFM	VELOCITY	PRESSURE AT	Duct size D equivalent	Pipe sizes	GPM
Room 1	65.33	400	0.05"	6"	3/4	800
Room 2	112	450	0.05"	6.5"	1/2	500
Room 3	92.46/93	420	0.05"	6"	1/2	300



1.CALCULATE CFM FOR ROOM 1,2 AND 3
2.WRITE DUCT DIMENSIONS
3.Make a table and fill in values for blanks

Q17. What are the types of Air Ventilation Explain with the help of A neat sketch?

A17.
Natural Ventilation

1) single – side ventilation

2) cross flow ventilation

3) stack ventilation

4) Top - down ventilation

➢ Forced ventilation.

1) positive pressure

2) Horizontal Mechanical

3) Hydraulic

Q18. Draw the flow chart for building survey/Project?

Source : ASHRAE Handbook 2013

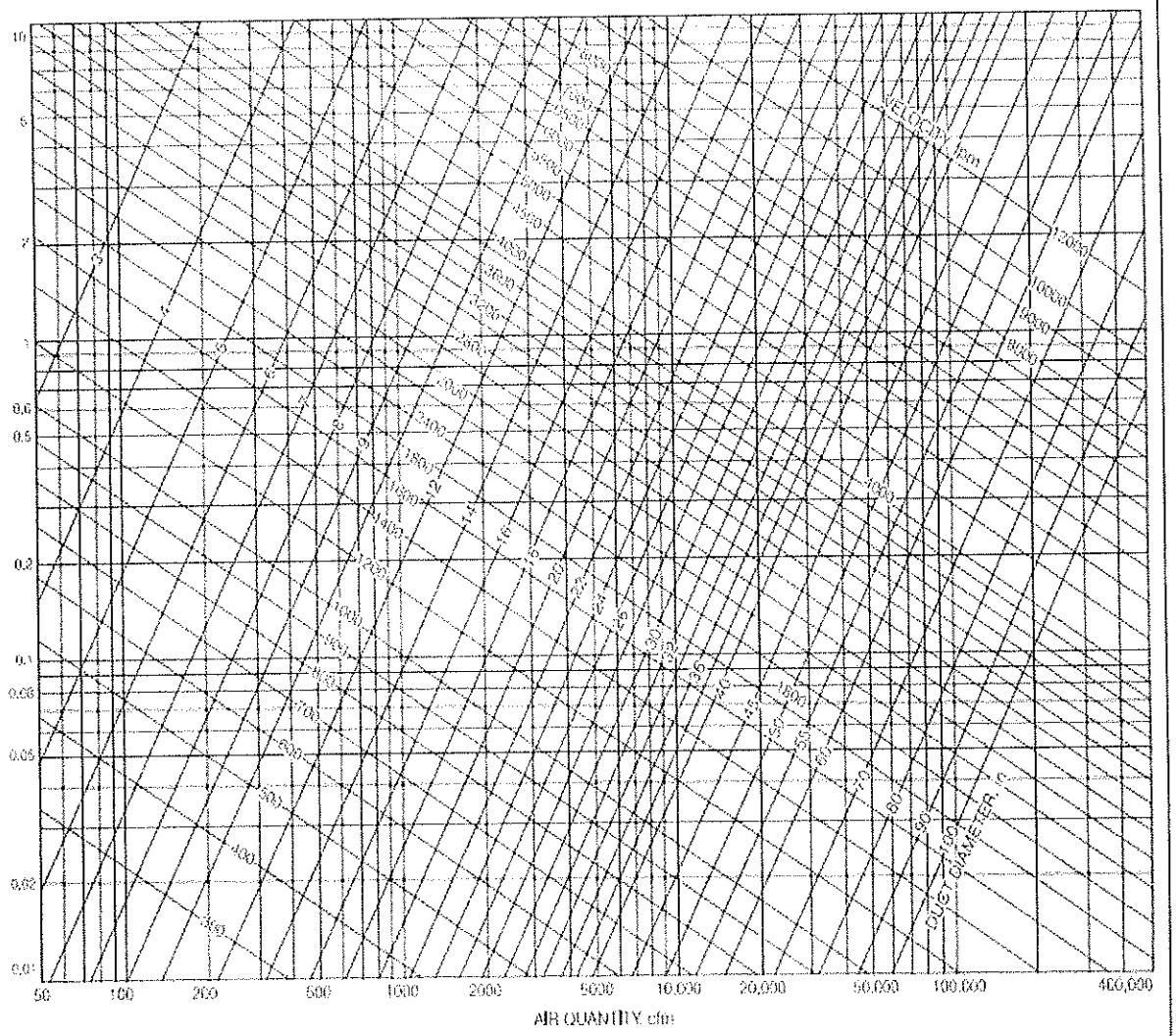
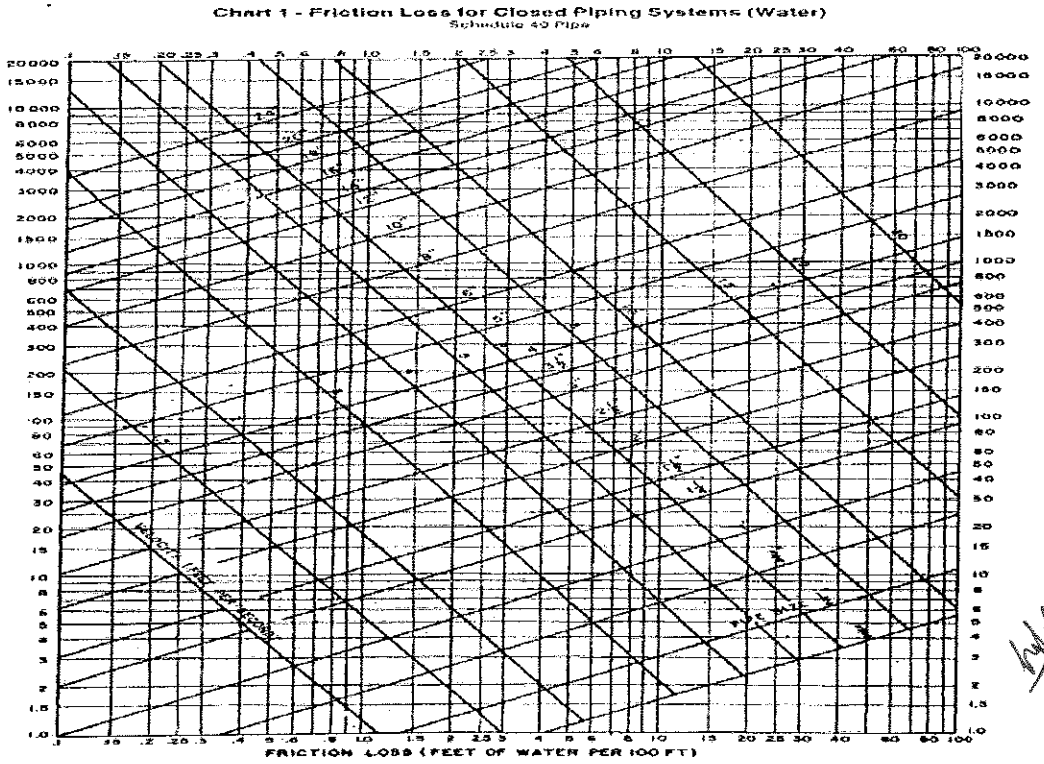


Figure 2.7 : Rigid Duct Design - Friction Chart
Friction chart for Round Duct, Air Density = 0.075 lb/ft3 and ε =0 0.003 ft.



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

B.

Registration No.: .....

School of Refrigeration & Air conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, V-Semester,

End Sem. Examination

Set-B

Time: 2 Hour

Course Code: HVA1504

Max. Marks: 50

Course Name: AC system & Testing

Instruction:

1.Read the question carefully.

2.Take given dimensions in Inches or convert them.

Section – A

05X01 = 05 Marks

Q1. Supply Air Duct-(SAD)_____

a) Carries the supply air from A.H.U to room.
b) Carries supply water from Ahu to Room.
c) Carries air return to A.H.U
d) Carries air in supply Line.

Q2. CFM determines the _____

a) Volume
b) Space
c) Duct height
d) Air velocity

Q3. Pipe is designed for _____

a) Pressure
b) Head pressure
c) To ensure Flow rate
d) Set back

Q4. Q4. Primary water loop connects _____

a) Chiller and ahu
b) F.C.U
c) Fain coil & Cooling tower
d) Condenser & A.H.U

Q5. LEED Is to regulate

a) Environment
b) Safety
c) Fire & hazard
d) Depression stresses

Q6. GPM determines_____?

a) Flow
b) Flow rate
c) Velocity
d) Space

Q7 Fire dampers are certified by.

a) Under writer's laboratory
b) Din
c) Space concern
d) Volume

Q8) Attic Space is the space _____?

a) Between BOFC & SSLB
b) SLAB & FFL
c) BOFC & FFL
d) SSLB & WINDOW

Q10. Pipe work has _____& _____?

a) Flow & Velocity
b) Velocity
c) Kinetic energy
d) Stress

Section – B

04X04 = 16 Marks

Q11. Types of evaporator used in chillers with diagram ?

Q12. Limitation and advantages of Scroll and reciprocating Compressor?

Q13. Using the continuity equation calculate the sizes of duct?
whose area is.

1)100 sq ft
2)156 sq inches
3) 64 sq ft
4) 225 sq inches

Q14. What are the Types of compressor used in central plant (Chiller) with Neat and diagram?

Section – C

06X04 =24Marks

Q15. For the given dimension of duct find (Using sheet of 8*3=3456sq inch)

a) Number of sheets required
b) Weight of duct take density =7.85 kg/m^2

1. 20" × 20" ×10"

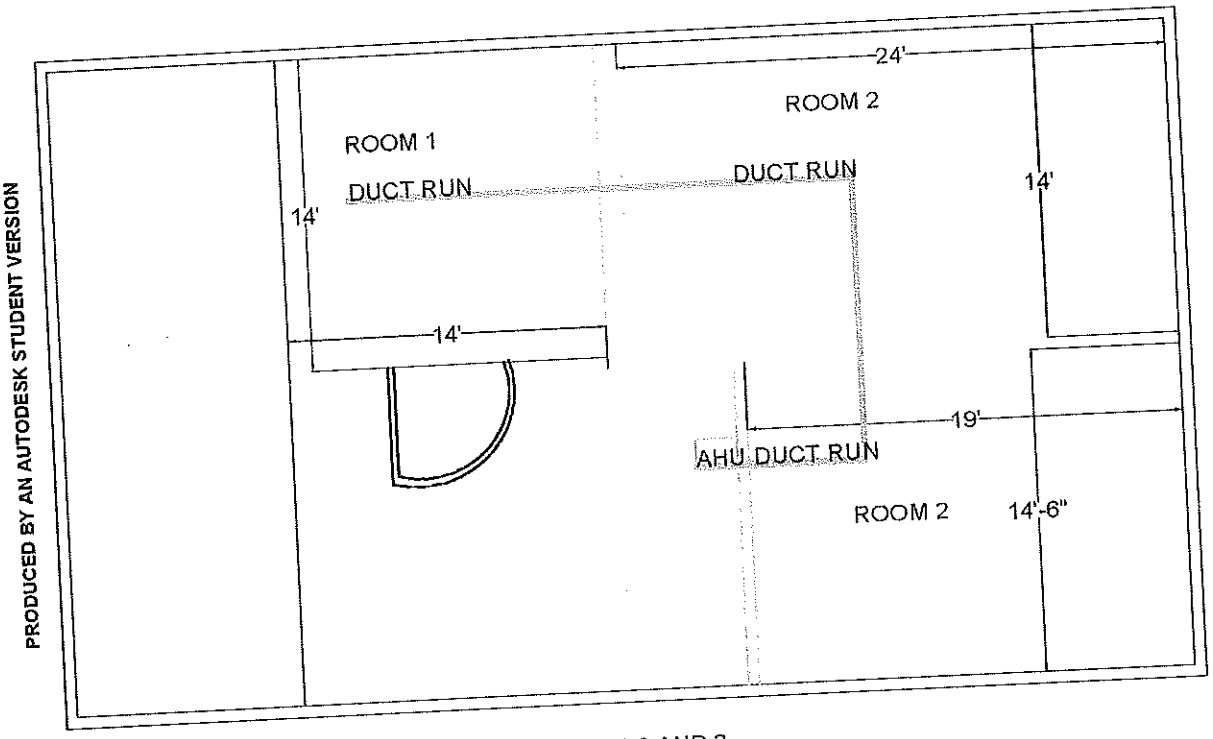
Q16. Calculate the required CFM and design the Duct for given building? Height to take 10.'

1) CFM of air required

2) Line diagram for duct design using EFM

3) Line diagram for duct design using EFM.

DUCT	CFM	VELOCITY	PRESSURE AT	Duct size D equivalent	Pipe sizes	GPM
						800
Room 1		400	0.05"			500
Room 2		450	0.05"			300
Room 3		420	0.05"			



1.CALCULATE CFM FOR ROOM 1,2 AND 3
2.WRITE DUCT DIMENSIONS
3.Make a table and fill in values for blanks

Q17. What are the types of Air Ventilation Explain with the help of A neat sketch?

Q18. What are the differences between AHU & FCU ?

Source : ASHRAE Handbook 2013

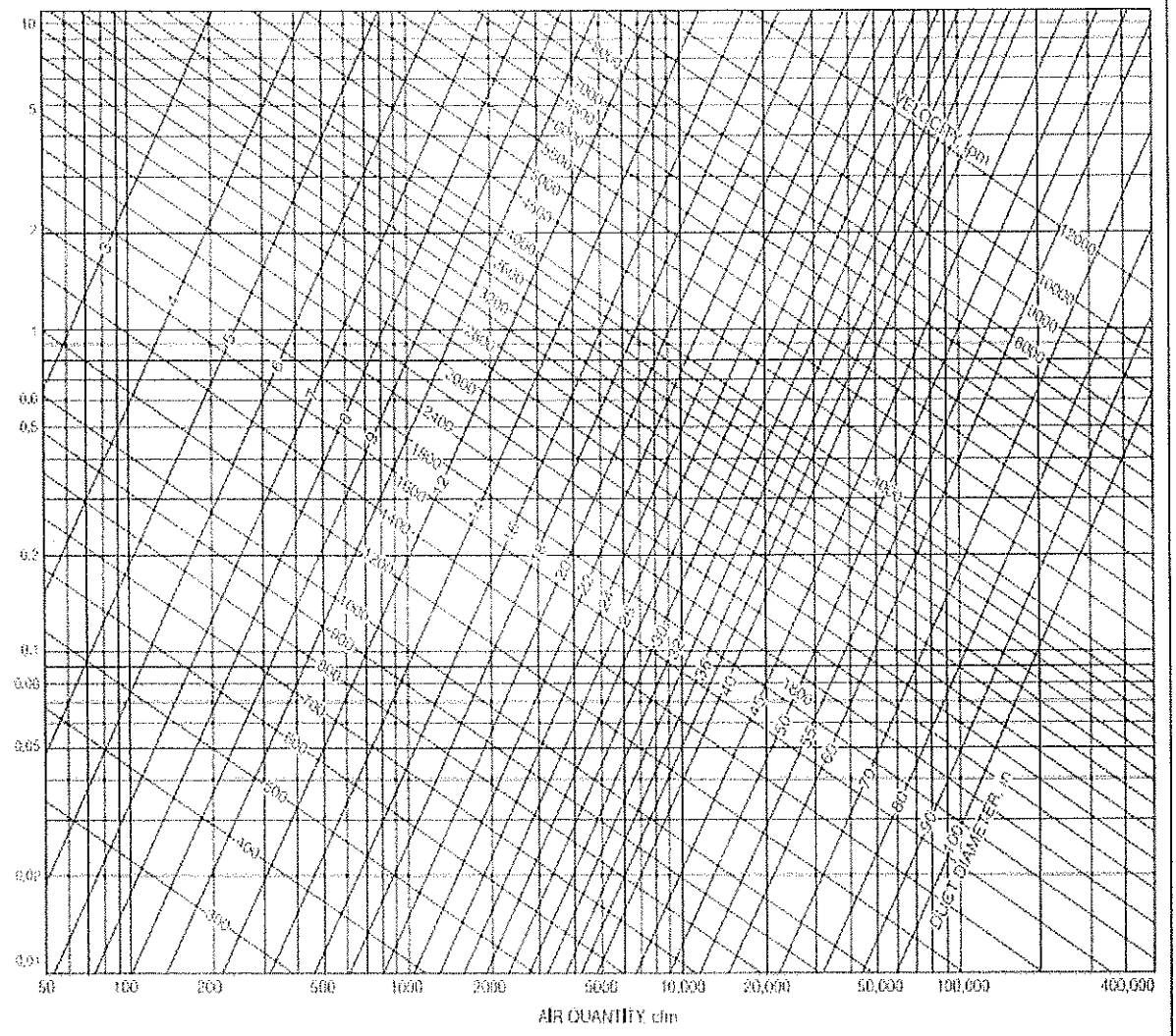
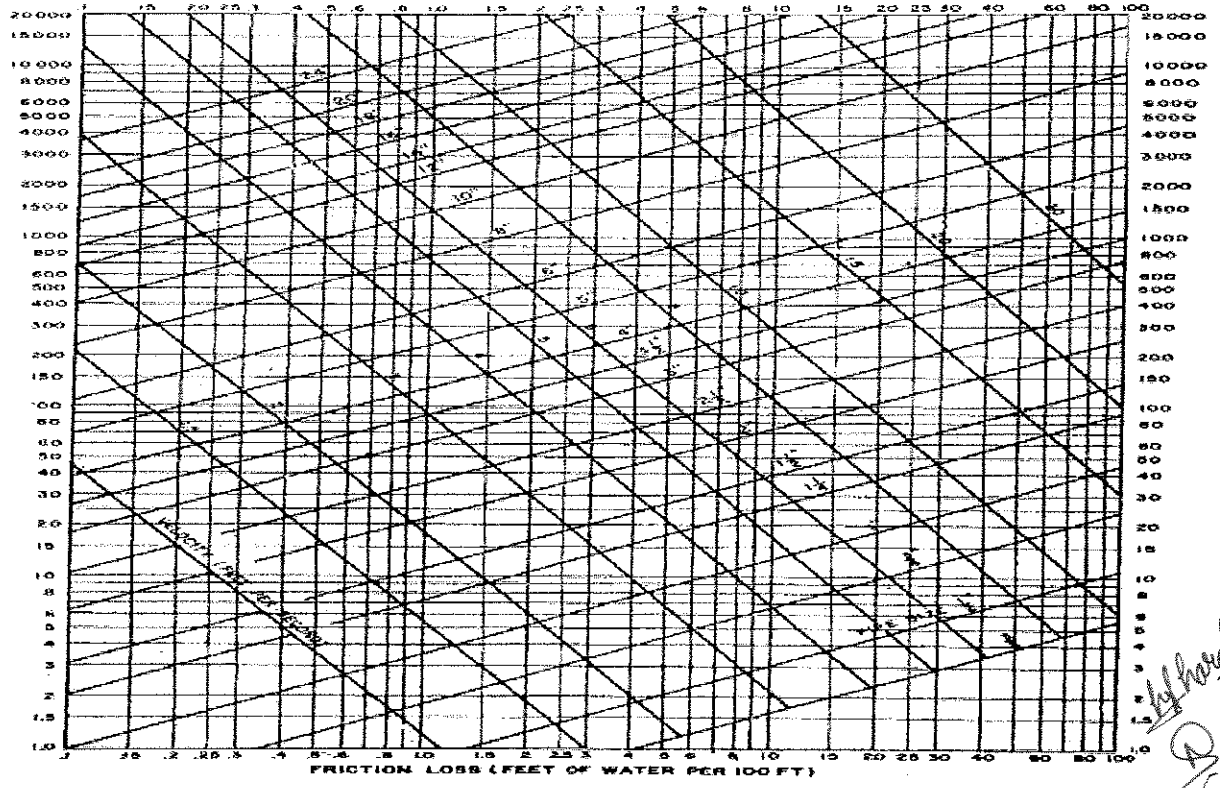


Figure 2.7 : Rigid Duct Design - Friction Chart
Friction chart for Round Duct, Air Density = 0.075 lb/ft3 and ε = 0.003 ft.

Chart 1 - Friction Loss for Closed Piping Systems (Water)
Schedule 40 Pipe



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

Registration No.: .....

School of Refrigeration & Air conditioning Skills

Session: 2020-21 (Summer Semester)

B. Voc. Program, V-Semester,

End Sem. Examination

Course Code: HVA 1504 Answer Key **Time: 2 Hour**

Course Name: AC system & Testing **Max. Marks: 50**

Instruction:

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Section – A

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Q1. Supply Air Duct-(SAD)_____

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Q5) LEED Is to regulate

a) Environment

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b) Flow rate

Q7 Fire dampers are certified by.

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Q8) Attic Space is the space _____?

a) Between BOFC & SSLB

Q10. Pipe work has _____& _____?

a) Flow & Velocity

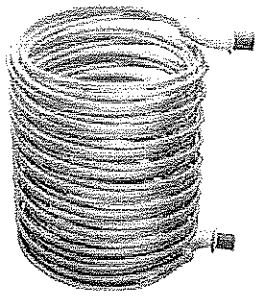
Section – B

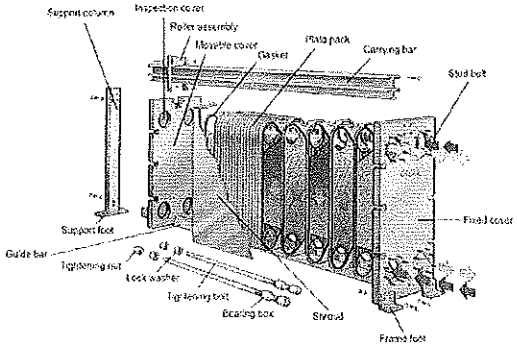
04X04 = 16 Marks

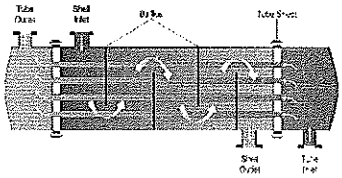
Q11. Types of evaporator used in chillers with Diagram ?

A11. Types of evaporator used in chillers with diagram.

1.**Shell Type**-Used where the load is low with space constrain spiral tube in form of coil is shaped to cool the secondary refrigerant.
2.**Plate heat exchanger type**- here two concentric plates are sandwiched between the tube where aluminum plates used as a fin to increase area for heat transfer
3.**Flooded shell and tube**- here tubes carry refrigerant or secondary refrigerant and as per the application shell part are exposed to these number of tubes for better heat transfer coefficient.







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Section – C 06X04 =24Marks

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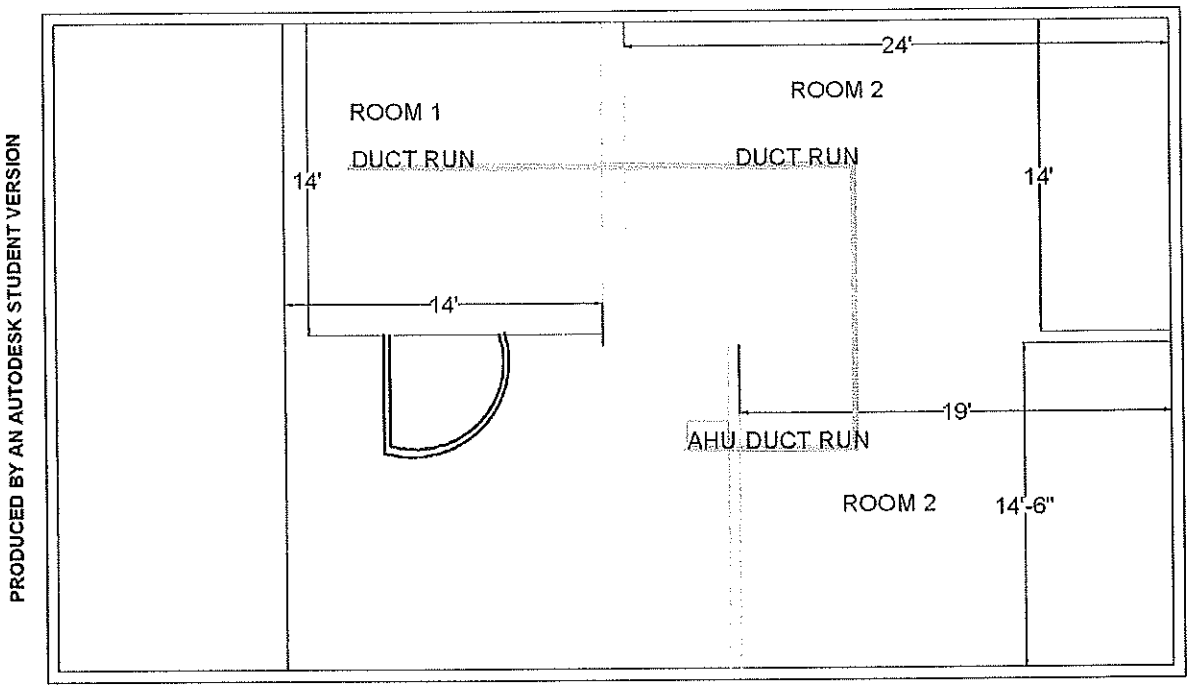

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2.WRITE DUCT DIMENSIONS
3.Make a table and fill in values for blanks

Q17. What are the types of Air Ventilation Explain with the help of A neat sketch?

A17. Ventilation is the Exchange of Room air with Fresh air. Sending Foul air out from the room/space and supplying fresh air into the room/space. Ventilation is a vital requirement for the comfort and health of building occupants.

There are 2 methods that may be used to ventilate a building.

Natural Ventilation

1) single – side ventilation 2) cross flow ventilation 3) stack ventilation 4) Top - down ventilation

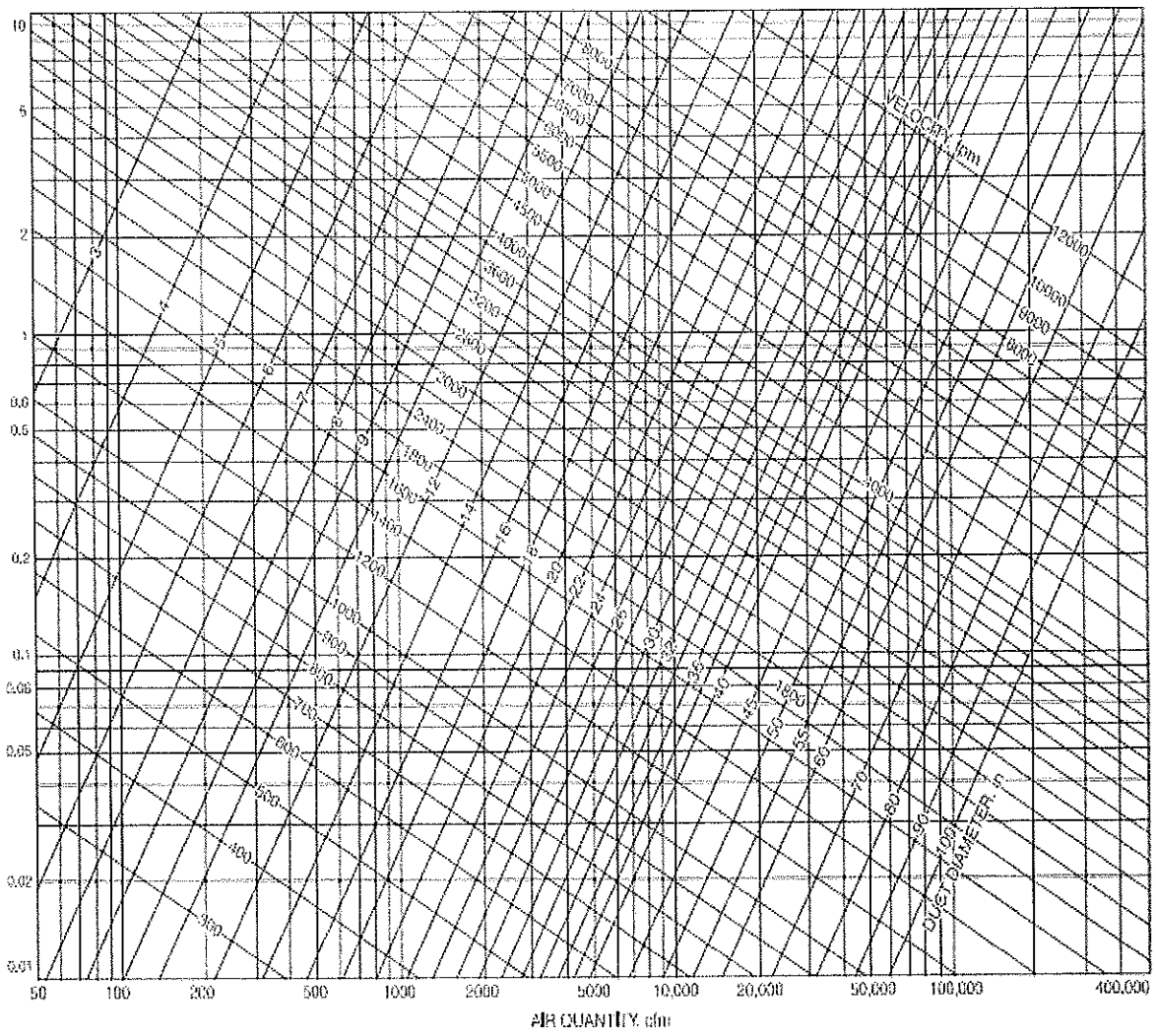
Forced ventilation 1) positive pressure 2) Horizontal Mechanical 3) Hydraulic

Q18. Difference between A.H.U & F.C.U?

A18.

AHU'S	FCU'S
AHU's are often used outside, especially as rooftop units	FCU's have only one fan, whereas AHU's can have multiple fans
AHU's often have different controls for parts of the system, for instance they might	FCU's are generally used for controlling the space where they are installed. AHU's are

have temperature sensors, actuators, and humidity sensors.	part of a larger system.
AHU's are more complex and can have sections for humidifying and reheating. They often have vibration isolators, mixing chambers, and other components. Since they often take air from outside, they almost always have a filter of some sort in the first section of the device so that the debris from the air does not contaminate the other sections.	FCU's don't generally use ductwork to cool or heat air. The fan pulls the air over the coil. FCU's can handle water.



Source : ASHRAE Handbook 2013

Figure 2.7 : Rigid Duct Design - Friction Chart
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Chart 1 - Friction Loss for Closed Piping Systems (Water)

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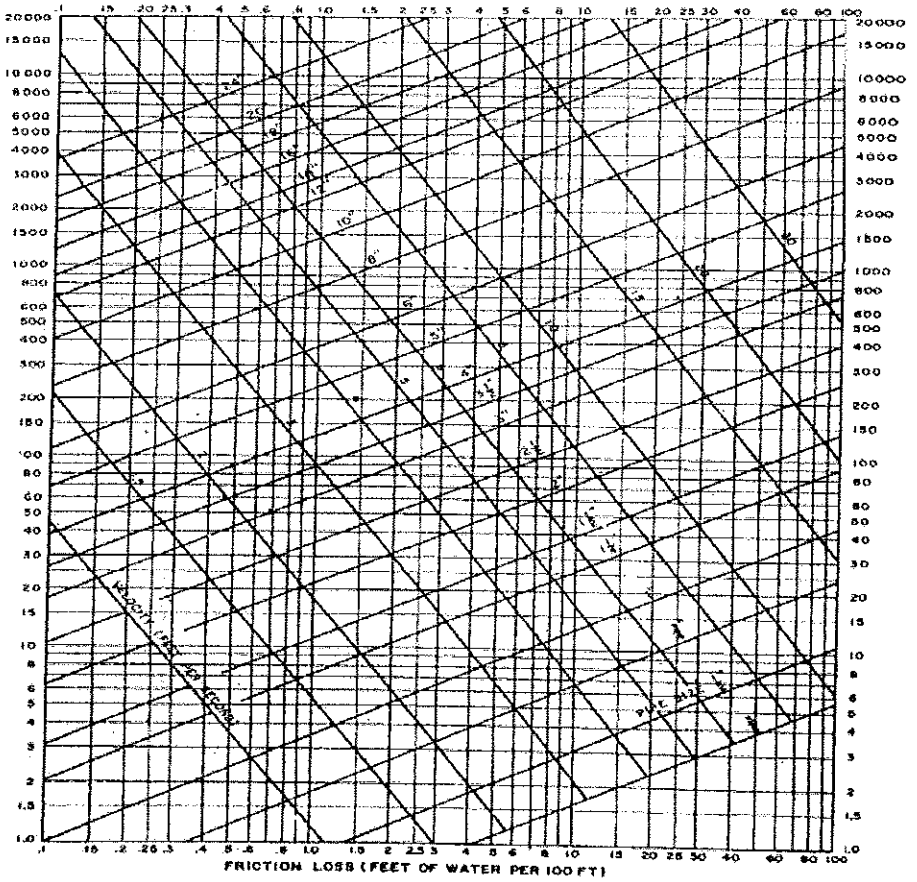

Harshdeep Sharma

Singh